1989 Annual Report

GENERAL MILLS EAST HENNEPIN AVENUE SITE

Prepared for GENERAL MILLS, INC.

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By BARR ENGINEERING CO.

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1989 ANNUAL REPORT

GENERAL MILLS, EAST HENNEPIN AVENUE SITE

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INTRODUCTION

This report summarizes monitoring data and remedial action operations conducted during 1989, and presents a recommended monitoring plan for 1990. The 1989 monitoring was carried out in response to the requirements of Part II of Exhibit A to the October 23, 1984 Response Order by Consent between General Mills and the Minnesota Pollution Control Agency (MPCA); the January 1985 Groundwater Pump-out System Plan - General Mills East Hennepin Avenue Site; the Minnesota Department of Natural Resources Water Appropriation Permits (85-6144 and 85-6145); the NPDES Permit MN 0056022; and, the 1989 Monitoring Plan. The East Hennepin Avenue Site is located in Minneapolis, Minnesota (Figure 1). The generalized geologic column for the site is shown in Figure 2.

REMEDIAL ACTION OPERATIONS

The following section summarizes the remedial action operation and maintenance activities conducted at the East Hennepin Avenue Site during 1989. The 1989 remedial actions consisted of operation of the groundwater pump-out system and the groundwater treatment system and long term monitoring of water levels and water quality in the glacial drift aquifer, the Carimona and Magnolia Members of the Platteville Formation, the St. Peter Sandstone, and the Prairie du Chien/Jordan formations.

Groundwater Pump-Out Systems

The East Hennepin Avenue groundwater pump-out systems consist of the site glacial drift pump-out system (pump-out Wells 109, and 110), the site Carimona pump-out system (Well 108), and a downgradient glacial drift pump-out system (pump-out Wells 111, 112, and 113).

The site glacial drift pump-out system is designed to contain and remove groundwater with a concentration of trichloroethene exceeding 270 µg/L from the glacial drift aquifer. The site Carimona pump-out system is designed to contain and remove groundwater with a concentration of trichloroethene exceeding 27 µg/L from the Carimona and Magnolia members of the Platteville Formation. Groundwater removed by both site pump-out well systems is treated by air stripping. The effluent from the air stripper is discharged to the Minneapolis storm sewer network. The site area pump-out system began operation on November 1, 1985.

The downgradient glacial drift pump-out system is designed to contain and remove groundwater with a concentration of trichloroethene exceeding 270 µg/L from the glacial drift aquifer. Groundwater removed by the downgradient pump-out well system is directly discharged to the Minneapolis storm sewer network. Passive air stripping occurs in the storm sewer between the downgradient pump-out system discharge point and the Mississippi River. The downgradient pump-out system began operation on December 5, 1985.

The site and downgradient pump-out wells were operated continuously at the maximum sustainable yield of the pumps or aquifer during 1989, with the exception of occasional shutdowns caused by electrical or mechanical failures, and the need for well maintenance. The pump controls of pump-out Well 109 failed intermittently between August and November 1989. The well received a new pump in November 1989. A pump control failure in Well 109 resulted in four days of downtime during December 1989. The pump controls of Well 110 failed in December 1988 and were replaced during January 1989. Pump control failures in Well 110 resulted in 20 days of downtime during October, November, and December 1989. Pump control failures in Well 108 resulted in 34 days of downtime during January 1989. Well 108 was shut down in December due to a failure in the discharge line. The discharge line was repaired during December 1989. Wells 108 and 109 are located on privately-owned property. Access to the property was limited during 1989, due to property owners closure of the site facility. Access in 1990 is not an anticipated problem. A full-time caretaker for the site has been hired as of January 1990. It is General Mills' understanding that the caretaker will provide access to the site.

The average monthly pumping rate for each of the pump-out wells is presented in Table 1. The combined average pumping rate for the site glacial drift pump-out well system during 1989 was 80 gallons per minute. The average pumping rate for the site Carimona pump-out system was 16 gallons per minute. The average monthly pumping rates for the individual pump-out wells ranged from 0 to 57 gallons per minute. A total volume of 42 million gallons of groundwater was removed from the glacial drift aquifer, and 8.7

million gallons of groundwater was removed from the Carimona and Magnolia Members of the Platteville Formation during 1989 by the site area pump-out well systems. The site area pump-out system operated at a combined yearly average running time of 85 percent.

The downgradient pump-out well system operated at a combined annual average rate of 290 gallons per minute. The average monthly pumping rates for the individual pump-out wells ranged from 90 to 107 gallons per minute. A total volume of 150 million gallons of groundwater was removed from the glacial drift aquifer during 1989 by the downgradient pump-out system. The downgradient pump out system operated at a combined yearly average running time of 100 percent.

Groundwater Treatment System

The groundwater treatment system consists of a stripper tower located at the former disposal site. The tower is designed to remove 99 percent of volatile organic compounds from influent groundwater at a discharge rate of 150 gpm. The groundwater treatment system is required to treat influent groundwater to a concentration of trichloroethene not to exceed 50 µg/l, and a daily maximum concentration of trichloroethene not to exceed 100 µg/l. The tower receives influent from glacial drift pump-out Wells 109 and 110 and from Carimona Member pump-out Well 108. The stripper tower began operation on November 11, 1985 and has operated within NPDES permit standards through the 1989 third quarter monitoring event (July 1989). The site pump-out and treatment system operated intermittently following the third quarter 1989

monitoring event due to pump control problems and a plugged air flow sensor in the stripper tower. The air flow sensor is a fail-safe device which prevents the pump-out wells from operating when the stripper tower fan is not operating. A plugged air flow sensor caused the pump-out wells to shutdown on December 20, 1989. The stripper tower fan continued to operate.

The air flow sensor was repaired on December 21, 1989 and the pump-out wells were restarted. Immediately following fourth quarter sampling on December 21, 1989 the pump-out and treatment system shutdown again. The system most likely would not operate due to the presence of ice inside the stripper tower. The "ice build-up" formed when the pump-out wells shut down on December 30, 1989 and the stripper tower fan continued operating. The fan was pulling -20°F air through the stripper tower.

The treatment system was restarted on December 25, 1989. Between December 20, 1989 and December 25, 1989, the outside air temperatures were in the 30°F range; the stripper tower's building heat was turned up; and, the stripper tower fan was shut off. This combination likely allowed the ice inside the tower to melt.

The treatment system operated continuously between December 25, 1989 and January 19, 1990 when it was shut down due to a loss of treatment efficiency. This occurrence is discussed in more detail in the Discussion of Water Quality Data Results section of this report.

GROUNDWATER MONITORING

Water Level Monitoring

The 1989 monitoring program involved the measurement of water levels from thirteen wells screened in the glacial drift; twelve wells open to the Carimona Member of the Platteville Formation; five wells open to the Magnolia Member of the Platteville Formation; four wells screened in the St. Peter Sandstone; and, one well screened in the Prairie du Chien and Jordan formations. The monitoring activities were carried out in accordance with the 1989 Monitoring Plan and the Quality Assurance/Quality Control Plan.

Glacial Drift

Groundwater elevations were measured in the glacial drift monitoring wells during April, July and October 1989 at the locations shown in Figure 3. The results from 1989 water level monitoring are presented in Table 3. A cross section of the glacial drift groundwater surface for the three monitoring periods is shown in Figure 4. The location of cross section A-A' is shown on Figure 3. The glacial drift groundwater contours and the estimated capture zone limits for the site glacial drift pump-out system for each monitoring period are shown in Figures 5 through 7.

The groundwater elevation data indicate the direction of groundwater flow in the glacial drift is to the southwest. The 1989 data is consistent with the groundwater elevation data collected during prior monitoring years.

Water level measurements collected during 1985-1986, following start-up of the groundwater containment system, demonstrated the effectiveness of the site and downgradient pump-out systems in containment of those areas of the glacial drift groundwater with volatile organic compound concentrations greater than 270 µg/L. Glacial drift groundwater elevation data collected during 1989 indicate the capture zone established during 1985 and 1986 following start-up of the pump-out systems has been maintained.

Carimona Member of Platteville Formation

Groundwater elevations were measured in the Carimona monitoring wells during April, July, and October 1989 at the locations shown in Figure 8. The results from 1989 water level monitoring are presented in Table 3. The Carimona potentiometric surface elevations for each monitoring period are shown in Figures 9 through 11.

The potentiometric surface elevation of the Carimona in the vicinity of the East Hennepin Avenue Site during 1989 was essentially flat. The results of potentiometric surface elevation monitoring collected from Carimona monitoring wells prior to 1989 also indicate a flat potentiometric surface. The average annual fluctuation of the potentiometric surface for the Carimona during 1989 was 1.8 feet. The data does not indicate a significant change in the slope of the Carimona's potentiometric surface has occurred in 1989.

Water level data for the Carimona member cannot be used to determine the real extent of the Carimona pump-out system because of the very low observed hydraulic gradients across the site, and the absence of monitoring points at some distance from the site. The water level data appear to suggest hydraulic gradients toward pumping Well 108 throughout the monitored area during 1989.

Magnolia Member of Platteville Formation

The potentiometric surface elevations were measured in the Magnolia monitoring wells during April, July, and October 1989 at the locations shown in Figure 12. The results from 1989 water level monitoring are presented in Table 4. The Magnolia potentiometric surface elevations for each monitoring period are shown in Figures 13 through 15.

The 1989 potentiometric surface elevation data indicate the direction of groundwater flow in the Magnolia Member is to the northwest with a hydraulic gradient of 0.005 feet/foot. This data is consistent with the potentiometric surface elevation data collected during prior monitoring years.

St. Peter Sandstone

The potentiometric surface elevations were measured in the St. Peter monitoring wells during April, July, and October 1989 at the locations in Figure 16. The results from 1989 water level monitoring are presented in

Table 5. The St. Peter potentiometric surface elevations for each monitoring period are shown in Figures 17 through 19.

The 1989 potentiometric surface elevation data indicate the general direction of groundwater flow in the St. Peter Sandstone is to the southwest. This data is consistent with the potentiometric surface elevation data collected during prior monitoring years.

WATER QUALITY DATA

The 1989 monitoring program involved the collection of water quality samples from monitoring wells screened in the glacial drift aquifer; open to the Carimona Member of the Platteville Formation; open to the Magnolia Member of the Platteville Formation; screened in the St. Peter Sandstone; and, screened in the Prairie du Chien and Jordan formations. The monitoring activities were carried out in accordance with the 1989 Monitoring Plan and the Quality Assurance/Quality Control Plan.

Glacial Drift

Groundwater samples were collected from thirteen monitoring wells screened in the glacial drift during April 1989 and from six glacial drift monitoring wells during July and October 1989. The samples collected during April were analyzed for the parameters in Table 6. The samples collected during July and October were analyzed for trichloroethene (TCE). The results from laboratory analysis are presented in Table 7. The reported

concentrations of TCE and the sum of volatile organic compounds (VOCs) are also shown in Figures 20 through 23. The concentration of TCE versus time for glacial drift Wells Q, S, T, X, 1, B, V, 3, and 4 are plotted in Figure 24.

Carimona Member of Platteville Formation

Groundwater samples were collected from 11 monitoring wells open to the Carimona Member of the Platteville Formation and pump-out Well 108 during April 1989 and from four Carimona Member monitoring wells during July and October 1989. Groundwater samples were also collected from pump-out Well 108 in April, July, and December 1989. The samples collected during April were analyzed for the parameters in Table 6. The samples collected in July, October, and December were analyzed for TCE. The results from the laboratory analysis are presented in Table 8. The concentration of TCE and the sum of VOCs are also shown in Figures 25 through 28. The concentration of TCE versus time for Carimona Wells, BB, WW, 10, 11, 13, and 108 is plotted in Figure 29.

Magnolia Member of Platteville Formation

Groundwater samples were collected from five monitoring wells open to the Magnolia Member of the Platteville Formation during April 1989 and from three Magnolia Member monitoring wells during July and October 1989. The samples collected during April were analyzed for the parameters in Table 6. The samples collected during July and October were analyzed for TCE. The

results from the laboratory analysis are presented in Table 9. The concentration of TCE and the sum of VOCs are also shown in Figures 30 through 33. The concentration of TCE versus time for Magnolia Wells OO, VV, and ZZ are plotted in Figure 34.

St. Peter Sandstone

Groundwater samples were collected from St. Peter Monitoring Well 200 during April, July, and October 1989. Water samples from St. Peter monitoring Wells 201, 202, and 203 were collected during April 1989. Samples collected during April were analyzed for the parameters in Table 6. Samples collected during July and October were analyzed for TCE. The results from the laboratory analysis are presented in Table 10. The concentration of TCE and the sum of VOCs are shown in Figures 35 through 38.

Prairie du Chien/Jordan

Groundwater samples were collected from the former Henkel production well during April, July, and October 1989. The samples were analyzed for the parameters in Table 6. The results from the laboratory analysis are presented in Table 11.

Groundwater Pump-out Systems

Flow-weighted composite groundwater samples were collected from the site glacial drift pump-out well system discharge during January, April, July,

and December 1989. Flow weighted composite groundwater samples were collected from the downgradient pump-out well system discharge during January, April, July, and October 1989. The samples collected during April and October were analyzed for the parameters in Table 12. The samples collected during January and July were analyzed for TCE. The results from the laboratory analysis are presented in Table 13. The concentration of TCE versus time for the groundwater pump-out system discharge is shown in Figure 39.

The results from the laboratory analysis of the discharge of the site pump-out system sample for volatile fraction priority pollutants during April 1989 are presented in Table 15.

Groundwater Treatment System

Groundwater treatment system influent and effluent samples were collected during January, April, July, and December 1989. The samples collected during April and December were analyzed for the parameters in Table 12. The samples collected during January and July were analyzed for TCE. The results from the laboratory analysis are presented in Table 15. The concentration of TCE versus time for the groundwater treatment system effluent is shown in Figure 39.

QUALITY ASSURANCE PROCEDURES

Quality assurance procedures described in the February 1985 Quality Assurance/Quality Control (QA/QC) Plan were followed during collection and analysis of the samples. Quality assurance procedures involved internal and external quality review procedures. The results from the quality review are in Appendix A. The quality control review indicates the results are representative of study area conditions.

DISCUSSION OF WATER QUALITY DATA RESULTS

Glacial Drift

The results from the analysis of groundwater samples collected from monitoring wells screened in the glacial drift are similar to water quality data reported during 1987 and 1988. This data indicates the downgradient glacial drift pump-out system is capturing glacial drift groundwater with a concentration of TCE exceeding 270 µg/l; and, the site glacial drift pump-out system remains an effective control for the containment of the groundwater contaminants located in the vicinity of the site.

Carimona Member of Platteville Formation

The results from the analysis of groundwater samples collected from the Carimona monitoring wells are similar to the data reported during 1987 and

1988. The 1989 data also indicates the groundwater quality of the Carimona in the vicinity of Well BB is improving.

The results from the analysis of samples collected from Wells 11 and 13 during 1985 through 1989 show considerable variability. The groundwater quality in the vicinity of Carimona Well 13 appears to be adversely impacted by leakage of Magnolia groundwater to the Carimona Formation. The concentration of TCE in the samples of groundwater collected from Magnolia Well ZZ is consistently higher than the concentration of TCE in samples collected from Carimona Well 13. The groundwater gradient at this location is from the Magnolia to the Carimona Member of the Platteville Formation. Carimona Well 13 and Magnolia Well ZZ are part of a well nest located at the corner of 21st Avenue Southeast and Fairmont. Carimona Well 11 is located between Carimona Well 13 and Carimona pump-out system.

Magnolia Member of Platteville Formation

The results from the analysis of groundwater samples collected from the Magnolia wells during 1989 ranged from 3.7 to 200 µg/l. The highest concentrations of TCE were reported for samples collected from Magnolia Wells OO, VV and ZZ. These wells are located upgradient of the former disposal area, and the water quality of samples collected from these wells appears to be adversely impacted by an unknown source located to the southeast of the East Hennepin Avenue site.

St. Peter Sandstone

The results from the analysis of groundwater samples collected from the St. Peter wells during 1989 indicate concentrations of TCE in Wells 201, 202, and 203, were either trace or below laboratory detection limits. The results from the analysis of groundwater for samples collected from these monitoring wells are similar to the data reported during 1987 and 1988. The results from analysis of samples collected from Well 200 during 1989 indicate concentrations of TCE which ranged from 120 to 150 µg/l. These concentrations are also similar to the concentrations of TCE reported for samples collected from Well 200 during 1987 and 1988.

Prairie du Chien/Jordan

The 1989 results from the analysis of groundwater samples collected from the former Henkel well indicate concentrations of TCE which ranged from 10 to 12 µg/l. The 1989 results of analysis are similar to the results from analysis of samples collected from the former Henkel production well during 1987 and 1988.

Groundwater Pump-out Systems

The results from the analysis of samples collected quarterly from the site pump-out system indicate the average influent concentration of TCE was 400 µg/l, and the average influent concentration of VOCs was 420 µg/l. The highest concentration of TCE reported in site pump-out system discharge

samples during 1989 was 440 µg/l. The maximum total concentration of VOCs reported was 480 µg/l. The influent concentrations of VOCs reported in 1989 are similar to the concentrations of VOCs reported for the site pump-out system influent during 1987 and 1988.

The volatile fraction priority pollutant data and the routine volatile organic data indicate TCE is the primary volatile organic compound present in the groundwater at the East Hennepin Avenue Site. This data also indicates that only five other VOCs were detected at the site including 1,1-dichloroethane, 1,2-dichloroethane, 1,2-dichloroethylene (cis/trans), tetrachloroethane, and 1,1,1-trichloroethane.

The average concentration of TCE reported for samples collected from the downgradient pump-out system effluent was 170 µg/l, and average total concentration of effluent VOCs was 180 µg/l. The highest effluent concentration of TCE reported during 1989 was 210 µg/l and the highest effluent concentration of total VOCs reported during 1989 was 220 µg/l. The concentrations of effluent VOCs are similar to the concentrations reported during 1987 and 1988.

Groundwater Treatment System

The average concentration of TCE reported for samples collected during the first, second and third quarters of 1989 from the effluent of the groundwater treatment system was 14 µg/l, and the average total concentration of VOCs was 16 µg/l. The maximum TCE concentration reported was 20 µg/l and

the maximum total concentration of VOCs was 20 µg/l. The data collected during the first, second and third quarters of 1989 indicate the average treatment efficiency of the groundwater treatment system is 96 percent removal of volatile organic compounds.

The results from laboratory analysis of the treatment system fourth quarter sampling event indicate the treatment system effluent concentration of TCE was 190 µg/L. This concentration exceeds the NPDES permit maximum allowable average TCE concentration (50 µg/L), and the maximum allowable daily concentration of TCE (100 µg/L). A second set of water quality samples from the groundwater treatment system effluent were collected and analyzed. The results from the laboratory analysis of these samples indicate the treatment system effluent concentration of TCE was 96 µg/L. This concentration also exceeds the NPDES permit maximum allowable average TCE concentration (50 µg/L). In response to this data, the site pump-out and groundwater treatment systems was shutdown on January 19, 1990.

Following shutdown, the stripper tower's interior was inspected (January 19, 1990). This inspection indicated the presence of a large amount of precipitate on the tower's packing and interior surfaces. The precipitate appeared to be calcium carbonate and had apparently channelized both water and air flow in the tower.

An estimated 20.3 million gallons of groundwater was discharged to the Minneapolis storm sewer system during the period between the third quarter 1989 treatment system monitoring and shutdown of the system on January 19,

1990. Some of the discharged treatment system effluent likely exceeded NPDES permit standards The ultimate discharge point of the storm sewer is the Mississippi River. The storm sewer route to the river includes a 96-foot drop from the storm sewer elevation to the discharge elevation at the Mississippi River.

It is unlikely that detectable concentrations of VOCs reached the Mississippi River. Passive air stripping occurs in the storm sewer as a result of the large drop to the Mississippi River. The effectiveness of the passive air stripping was demonstrated during the January 1984 Well 108 aquifer test monitoring.

The stripper tower is scheduled to be cleaned and repacked during April 1990. The site pump-out and groundwater treatment system will be restarted upon completion of this work.

SUMMARY AND CONCLUSIONS

Water level data collected in the glacial drift indicate the capture zone established in this aquifer during 1985 and 1986 has been maintained in 1989. Water quality data indicate continued containment of groundwater with a concentration of TCE exceeding 270 µg/L in the glacial drift aquifer.

Water level data collected in the Carimona Member of the Platteville Formation indicate the capture zone established in this aquifer during 1985 and 1986 was maintained through the fourth quarter 1989 monitoring event. Electrical and mechanical failures in October, November, and December resulted in 46 days of downtime for the pump in Well 108. This occurrence likely decreased the effective capture zone limits in the Carimona Member during the fourth quarter of 1989.

Magnolia Member water quality and water level data indicate the primary source of TCE in the Magnolia member is located upgradient of the East Hennepin Avenue Site.

Water quality data collected from the St. Peter Wells and Prairie du Chien/Jordan Well indicate the continued presence of VOCs in the St. Peter Sandstone and in the Prairie du Chien/Jordan aquifers.

RECOMMENDATIONS

1. Continued operation of the site pump-out and groundwater treatment systems in accordance with the 1985 Consent Order; the 1985 Groundwater Pump-Out System Plan; the Department of Natural Resources Water Appropriation Permits; and, the 1990 Monitoring Plan (Appendix B).

2. Continued monitoring of groundwater elevations and groundwater quality in accordance with the 1990 Monitoring Plan (Appendix B).

3. Annual monitoring of the stripper tower packing to verify that the packing material remains in an operable condition.

Tables

TABLE 1

1989 PUMPING RATES
PUMP-OUT WELLS

	GLACIAL DRIFT PUMP-OUT WELL Pumping Rate (Ave. GPM)					CARIMONA PUMP-OUT WELL Pumping Rate (Ave. GPM)
	109	110	111	112	113	108
Jan 1989	41	29	91	101	92	22
Feb 1989	51	50	91	104	92	20
Mar 1989	47	55	91	105	92	20
Apr 1989	57	44	91	106[1]	91	20
May 1989	50	50	91	106[1]	92	21
Jun 1989	49	50	90	104	92	20
Jul 1989	48	50	90	105	92	19
Aug 1989	20[2]	51	90	107	92	18
Sep 1989	8.2[2]	51	90	104	92	19
Oct 1989	0.0[2]	44[2]	90	104	93	1.8[2]
Nov 1989	16[2]	25[2]	90	106	93	5.6[2]
Dec 1989	45[2]	23[2]	90	106	93	12[2]

[1] Flow meter malfunction.

[2] Wells not pumping full-time due to faulty motor control.

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TABLE 2

1989 GROUNDWATER ELEVATIONS
GLACIAL DRIFT WELLS

(elevations in feet-MSL)

DATE	1	3	4	106	107
04/03/89	841.74	833.30	830.79	--	835.34
07/12/89	841.75	833.76	--	--	--
10/09/89	841.72	833.98	--	--	--

DATE	109 (1)	110 (1)	111 (1)	112 (1)	113 (1)
04/03/89	831.41	828.90	818.43	811.80	817.22
07/12/89	--	--	--	--	--
10/09/89	--	--	--	--	--

DATE	B	Q	R	S
04/03/89	843.17	827.45	DRY	825.23
07/12/89	--	827.95	DRY	825.55
10/09/89	--	828.26	DRY	826.45

DATE	T	U	V	W	X
04/03/89	832.25	835.72	814.19	814.34	DRY
07/12/89	832.41	--	814.77	814.86	822.05
10/09/89	832.23	--	815.16	815.26	DRY

---

(1) Pumping well.
-- Not measured.

2,.001

TABLE 3

1989 GROUNDWATER ELEVATIONS
CARIMONA MEMBER WELLS

(elevations in feet-MSL)

DATE	8	9	10	11	12	13	108 (1)
04/03/89	827.13	827.37	827.37	827.16	827.20	826.63	807.81
07/12/89	825.41	825.64	825.59	825.43	826.18	824.74	804.51
10/09/89	827.32	827.52	827.82	827.37	826.70	826.78	827.49

DATE	BB	RR	SS	UU	WW
04/03/89	827.34	827.35	825.54	827.31	827.31
07/12/89	--	825.65	823.62	--	--
10/09/89	--	827.57	825.12	--	--

(1) Pumping well.
-- Not measured.

2,.002

TABLE 4

1989 GROUNDWATER ELEVATIONS
MAGNOLIA MEMBER WELLS

(elevations in feet/MSL)

	OO	QQ	TT	VV	ZZ
DATE					
04/03/89	822.82	822.47	820.46	823.75	828.72
07/12/89	821.66	821.32	819.38	822.36	826.05
10/09/89	823.07	822.70	820.69	823.98	828.20

-- Not measured.

2,.003

TABLE 5

1989 GROUNDWATER ELEVATIONS
ST. PETER WELLS

(elevations in feet/MSL)

	200	201	202	203
DATE				
04/05/89	762.22	779.61	753.67	753.57
07/12/89	758.96	775.98	752.77	752.37
10/09/89	760.36	777.25	752.70	752.43

2,.004

TABLE 6

1989 WATER QUALITY
ANALYTICAL PARAMETERS

Chlorinated Volatile Solvents

1,1-Dichloroethane

1,2-Dichloroethane

1,2-Dichloroethylene, cis

1,2-Dichloroethylene, trans

1,1,2,2-Tetrachloroethane

Tetrachloroethylene

1,1,1-Trichloroethane

Trichloroethene

TABLE 7

1989 WATER QUALITY DATA
GLACIAL DRIFT WELLS

(concentrations in ug/L)

	B	Q	R			S		
	04/06/89	04/06/89	04/06/89	07/13/89	10/09/89	04/06/89	07/13/89	10/09/89
1,1-Dichloroethane	8.9	6.9	--	--	--	<4.0	--	--
1,2-Dichloroethane	<0.40	<0.2	--	--	--	<4.0	--	--
1,2-Dichloroethylene, cis	1.9	<0.5	--	--	--	49	--	--
1,2-Dichloroethylene, trans	<0.60	<0.3	--	--	--	<6.0	--	--
1,1,2,2-Tetrachloroethane	<2.0	<1.0	--	--	--	<20	--	--
Tetrachloroethylene	4.9	<1.0	--	--	--	<20	--	--
1,1,1-Trichloroethane	3.3	5.3	--	--	--	<10	--	--
Trichloroethene	250	1.1	--	--	--	860	620	630
Sum of Volatile Organics	270	13	--	--	--	910	620	630

	T	V			W			X
	04/04/89	04/05/89	07/13/89	10/09/89	04/05/89	07/13/89	10/09/89	04/04/89
1,1-Dichloroethane	<0.2	<0.2	--	--	<0.2	--	--	--
1,2-Dichloroethane	<0.2	<0.2	--	--	<0.2	--	--	--
1,2-Dichloroethylene, cis	<0.5	8.7	--	--	28	--	--	--
1,2-Dichloroethylene, trans	<0.3	0.4	--	--	0.7	--	--	--
1,1,2,2-Tetrachloroethane	<1.0	<1.0	--	--	<1.0	--	--	--
Tetrachloroethylene	<1.0	<1.0	--	--	<1.0	--	--	--
1,1,1-Trichloroethane	<0.5	<0.5	--	--	<2.5	--	--	--
Trichloroethene	<0.5	130	120	120	57	22	25	--
Sum of Volatile Organics	ND	140	120	120	86	22	25	--

	1			3			4
	04/04/89	07/13/89	10/13/89	04/06/89	07/13/89	10/09/89	04/04/89
1,1-Dichloroethane	<0.2	--	--	11	--	--	<0.2
1,2-Dichloroethane	<0.2	--	--	<1.0	--	--	<0.2
1,2-Dichloroethylene, cis	<0.5	--	--	13	--	--	1.0
1,2-Dichloroethylene, trans	<0.3	--	--	<1.5	--	--	<0.3
1,1,2,2-Tetrachloroethane	<1.0	--	--	<5.0	--	--	<1.0
Tetrachloroethylene	7.0	--	--	5.7	--	--	1.2
1,1,1-Trichloroethane	0.8	--	--	3.2	--	--	1.1
Trichloroethene	0.8	0.6 s	0.5	320	340	530	55
Sum of Volatile Organics	8.6	0.6	0.5	350	340	530	58

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

.005

TABLE 8

1989 WATER QUALITY DATA
CARIMONA MEMBER WELLS

(concentrations in ug/L)

	BB	RR	SS	UU	WW	8
	04/06/89	04/06/89	04/04/89	04/04/89	04/06/89	04/06/89
1,1-Dichloroethane	4.9	9.7	17	1.4	<10	3.1
1,2-Dichloroethane	<1.0	<0.40	<0.40	<0.2	<10	4.7
1,2-Dichloroethylene, cis	31	26	<1.0	11	14	26
1,2-Dichloroethylene, trans	<1.5	<0.60	<0.60	<0.3	0.5	0.4
1,1,2,2-Tetrachloroethane	<5.0	<2.0	<2.0	<1.0	<50	<1.0
Tetrachloroethylene	6.4	<2.0	<2.0	<1.0	<50	3.0
1,1,1-Trichloroethane	4.2	1.1	2.8	1.0	<25	0.7
Trichloroethene	340	180	1.3	38	530	380
Sum of Volatile Organics	390	220	21	51	540	420

	9			10		
	04/06/89	07/13/89	10/10/89	04/06/89	07/13/89	10/10/89
1,1-Dichloroethane	0.8	--	--	<0.2	--	--
1,2-Dichloroethane	5.4	--	--	<0.2	--	--
1,2-Dichloroethylene, cis	1.0	--	--	5.5	--	--
1,2-Dichloroethylene, trans	<0.3	--	--	<0.3	--	--
1,1,2,2-Tetrachloroethane	<1.0	--	--	<1.0	--	--
Tetrachloroethylene	<1.0	--	--	1.4	--	--
1,1,1-Trichloroethane	<0.5	--	--	2.9	--	--
Trichloroethene	9.8	9.9	12	160	99	140
Sum of Volatile Organics	17	9.9	12	170	99	140

	11			12		
	04/05/89	07/13/89	10/09/89	04/06/89	07/13/89	10/10/89
1,1-Dichloroethane	<1.0	--	--	<0.2	--	--
1,2-Dichloroethane	<1.0	--	--	<0.2	--	--
1,2-Dichloroethylene, cis	7.6	--	--	<0.5	--	--
1,2-Dichloroethylene, trans	<1.5	--	--	<0.3	--	--
1,1,2,2-Tetrachloroethane	<5.0	--	--	<1.0	--	--
Tetrachloroethylene	<5.0	--	--	<1.0	--	--
1,1,1-Trichloroethane	<2.5	--	--	<0.5	--	--
Trichloroethene	110	3.6	5.0	<0.5	2.1 s	<0.5
Sum of Volatile Organics	120	3.6	5.0	ND	2.1	<0.5

	13	108		
	04/05/89	04/06/89	07/13/89	12/21/89
1,1-Dichloroethane	<1.0	<1.0	--	<4.0
1,2-Dichloroethane	<1.0	<1.0	--	<4.0
1,2-Dichloroethylene, cis	8.1	37	--	45
1,2-Dichloroethylene, trans	<1.5	<1.5	--	<6.0
1,1,2,2-Tetrachloroethane	<5.0	<5.0	--	<20
Tetrachloroethylene	<5.0	<5.0	--	<20
1,1,1-Trichloroethane	<2.5	<2.5	--	<10
Trichloroethene	110	530	340	490
Sum of Volatile Organics	120	570	340	540

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

TABLE 9

1989 WATER QUALITY DATA
MAGNOLIA MEMBER WELLS

(concentrations in ug/L)

	OO			QQ	TT
	04/06/89	07/13/89	10/10/89	04/05/89	04/04/89
1,1-Dichloroethane	<0.2	--	--	<0.2	1.6
1,2-Dichloroethane	<0.2	--	--	0.2	<0.2
1,2-Dichloroethylene, cis	21	--	--	0.7	3.7
1,2-Dichloroethylene, trans	2.0	--	--	0.8	<0.3
1,1,2,2-Tetrachloroethane	<1.0	--	--	<1.0	<1.0
Tetrachloroethylene	<1.0	--	--	<1.0	<1.0
1,1,1-Trichloroethane	<0.5	--	--	<0.5	<1.0
Trichloroethene	90	70	67	3.7	30
Sum of Volatile Organics	110	70	67	5.4	35

	VV			ZZ		
	04/04/89	07/13/89	10/09/89	04/05/89	07/14/89	10/10/89
1,1-Dichloroethane	0.8	--	--	<1.0	--	--
1,2-Dichloroethane	0.5	--	--	<1.0	--	--
1,2-Dichloroethylene, cis	8.0	--	--	16	--	--
1,2-Dichloroethylene, trans	<0.3	--	--	<1.5	--	--
1,1,2,2-Tetrachloroethane	<1.0	--	--	<5.0	--	--
Tetrachloroethylene	<1.0	--	--	<5.0	--	--
1,1,1-Trichloroethane	2.0	--	--	<2.5	--	--
Trichloroethene	59	87	150	180	34	33
Sum of Volatile Organics	70	87	150	200	34	33

-- Not analyzed.

TABLE 10

1989 WATER QUALITY DATA
ST. PETER WELLS

(concentrations in ug/L)

	200			201	202	203
	04/05/89	07/14/89	10/10/89	04/05/89	04/05/89	04/05/89
1,1-Dichloroethane	<1.0	--	--	<0.2	<0.2	<0.2
1,2-Dichloroethane	<1.0	--	--	<0.2	<0.2	<0.2
1,2-Dichloroethylene, cis	13	--	--	<0.5	<0.5	<0.5
1,2-Dichloroethylene, trans	<1.5	--	--	<0.3	<0.3	<0.3
1,1,2,2-Tetrachloroethane	<5.0	--	--	<1.0	<1.0	<1.0
Tetrachloroethylene	<5.0	--	--	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	<2.5	--	--	<0.5	<0.5	<0.5
Trichloroethene	150	130	120	<0.5	<0.5	2.1
Sum of Volatile Organics	160	130	120	ND	ND	2.1

-- Not analyzed.

TABLE 11

1989 WATER QUALITY DATA
PRAIRIE DU CHIEN/JORDAN WELL

(concentrations in ug/L)

	HENKEL		
	04/04/89	07/24/89	10/13/89
1,1-Dichloroethane	1.5	1.5	1.1
1,2-Dichloroethane	<0.2	<0.2	<0.2
1,2-Dichloroethylene, cis	<0.5	<0.5	<0.5
1,2-Dichloroethylene, trans	<0.3	<0.3	<0.3
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0
Tetrachloroethylene	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethene	12	10	11
Sum of Volatile Organics	14	12	12

.002

TABLE 12

1989 GROUNDWATER PUMP-OUT
AND TREATMENT SYSTEM WATER
QUALITY PARAMETERS

Chlorinated Volatile Solvents

1,1-Dichloroethane

1,2-Dichloroethane

1,2-Dichloroethylene, cis

1,2-Dichloroethylene, trans

1,1,2,2-Tetrachloroethane

Tetrachloroethylene

1,1,1-Trichloroethane

Trichloroethene

Non-Chlorinated Volatile Solvents

Benzene

Toluene

Xylenes

TABLE 13

1989 WATER QUALITY DATA
PUMP-OUT WELLS 111, 112, 113

(concentrations in ug/L)

	DISCHARGE				
	01/31/89	04/06/89	07/14/89	10/10/89	01/16/90
1,1-Dichloroethane	--	1.1	--	<1.0	--
1,2-Dichloroethane	--	<0.2	--	<1.0	--
1,2-Dichloroethylene, cis	--	16	--	11 c	--
1,2-Dichloroethylene, trans	--	<0.3	--	12 c	--
1,1,2,2-Tetrachloroethane	--	<1.0	--	<5.0	--
Tetrachloroethylene	--	2.3	--	<5.0	--
1,1,1-Trichloroethane	--	2.4	--	<2.5	--
Trichloroethene	210	200	170	110	140
Benzene	--	<1.0	--	<5.0	--
Toluene	--	<1.0	--	<5.0	--
Xylenes	--	<1.0	--	<5.0	--
Sum of Volatile Organics	210	220	170	130	140

c Compounds coelute.
-- Not analyzed.

TABLE 14

1989 WATER QUALITY DATA
PUMP-OUT WELLS 108, 109, 110
(INFLUENT AND EFFLUENT)

(concentrations in ug/L)

	20100 INFLUENT				
	01/31/89	04/06/89	07/13/89	12/21/89	01/16/90
1,1-Dichloroethane	--	3.9	--	<2.0	--
1,2-Dichloroethane	--	<1.0	--	<2.0	--
1,2-Dichloroethylene, cis	--	16	--	5.0	--
1,2-Dichloroethylene, trans	--	<1.5	--	<3.0	--
1,1,2,2-Tetrachloroethane	--	<5.0	--	<10	--
Tetrachloroethylene	--	<5.0	--	<10	--
1,1,1-Trichloroethane	--	4.1	--	<5.0	--
Trichloroethene	390	440	380	140	380
Benzene	--	7.3	--	<10	--
Toluene	--	7.3	--	<10	--
Xylenes	--	<5.0	--	<10	--
Sum of Volatile Organics	390	480	380	150	380

	20100 EFFLUENT				
	01/31/89	04/06/89	07/13/89	12/21/89	01/16/90
1,1-Dichloroethane	--	<0.2	--	<2.0	--
1,2-Dichloroethane	--	0.7	--	<2.0	--
1,2-Dichloroethylene, cis	--	4.4	--	14	--
1,2-Dichloroethylene, trans	--	<0.3	--	<3.0	--
1,1,2,2-Tetrachloroethane	--	<1.0	--	<10	--
Tetrachloroethylene	--	<1.0	--	<10	--
1,1,1-Trichloroethane	--	<0.5	--	<5.0	--
Trichloroethene	9.8	13	20	190	96
Benzene	--	<1.0	--	<10	--
Toluene	--	<1.0	--	<10	--
Xylenes	--	<1.0	--	<10	--
Sum of Volatile Organics	9.8	18	20	200	96

-- Not analyzed.

TABLE 15

WATER QUALITY DATA
PRIORITY POLLUTANT VOLATILE ORGANIC ANALYSIS
EPA METHOD 624
PUMP-OUT WELLS 108, 109, 110 (INFLUENT)
April 6, 1989

(Concentrations in µg/l)

Parameter	Influent[1]	Trip Blank
Benzene	<12	<5.0
Bromodichloromethane	<12	<5.0
Bromoform	<12	<5.0
Bromomethane	<25	<10.0
Carbon tetrachloride	<12	<5.0
Chlorobenzene	<12	<5.0
Chloroethane	<25	<10.0
2-Chloroethylvinyl ether	<25	<10.0
Chloroform	<12	<5.0
Chloromethane	<25	<10.0
Chlorodibromomethane	<12	<5.0
1,1-Dichloroethane	<12	<5.0
1,2-Dichloroethane	<12	<5.0
1,1-Dichloroethene	<12	<5.0
1,2-Dichoroethylene (cis/trans)	19	<5.0
1,2-Dichloropropane	<12	<5.0
cis-1,3-Dichloropropene	<12	<5.0
trans-1,3-Dichloropropene	<12	<5.0
Ethyl benzene	<12	<5.0
Methylene chloride	<62	<25.0
1,1,2,2-Tetrachloroethane	<12	<5.0
Tetrachloroethene	<12	<5.0

[1] Flow rate weighted composite sample (pump-out Wells 108, 109 and 110).

TABLE 15 (Continued)
WATER QUALITY DATA
PRIORITY POLLUTANT VOLATILE ORGANIC ANALYSIS
EPA METHOD 624
PUMP-OUT WELLS 108, 109, 110 (INFLUENT)
April 6, 1989

(Concentrations in µg/l)

Parameter	Influent[1]	Trip Blank
Toluene	<12	<5.0
1,1,1-Trichloroethane	<12	<5.0
1,1,2-Trichloroethane	<12	<5.0
Trichloroethene	340	<5.0
Vinyl chloride	<25	<10.0

[1] Flow rate weighted composite sample (pump-out Wells 108, 109 and 110).

Figures

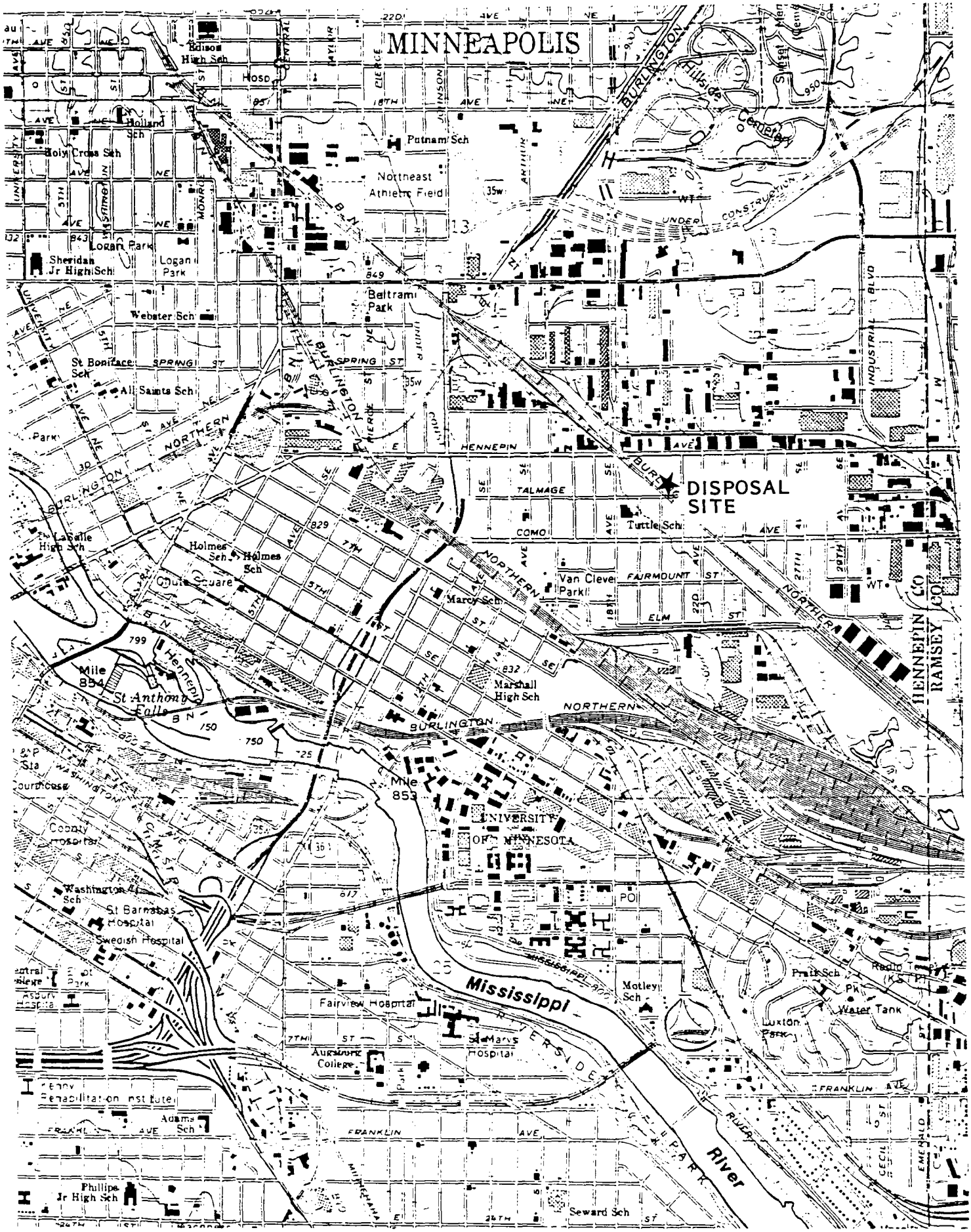
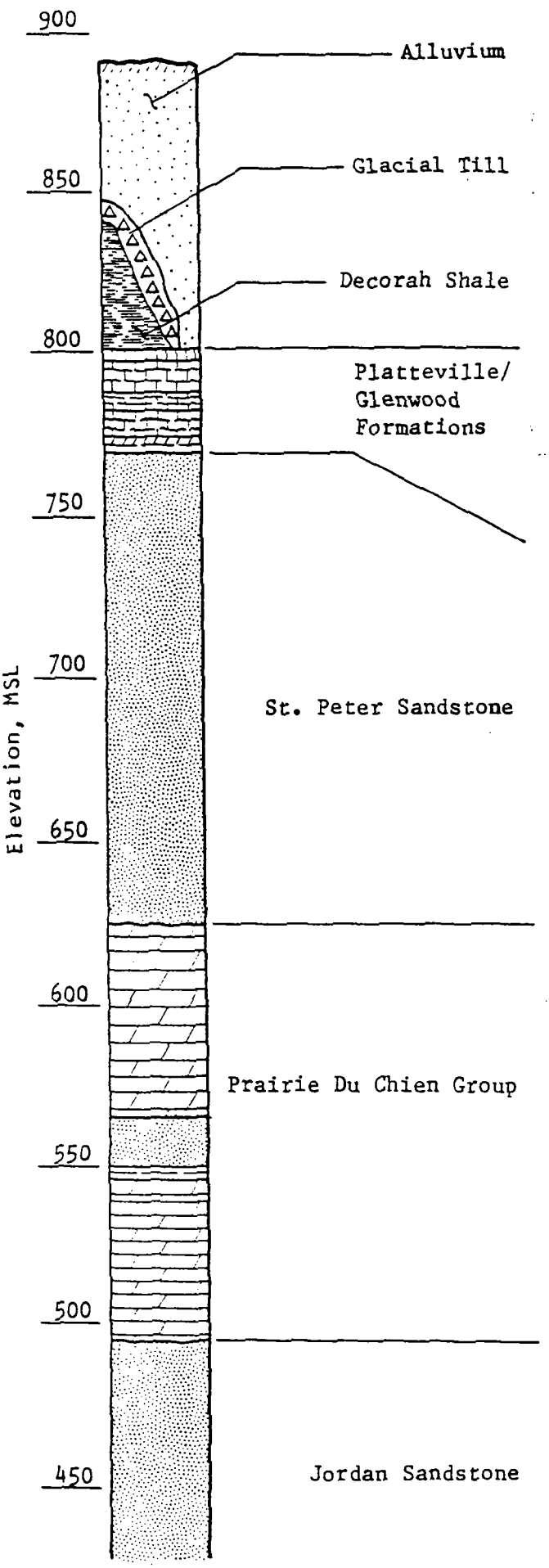


Figure 1

LOCATION OF DISPOSAL SITE



Sand, gravelly sand and silty sand, sometimes overlain by bogs and marshes which have been drained and filled. Overlying soil is variable in composition often clayey or silty. Deposits are terrace deposits from Glacial River Warren. Thickness ranges from 23 to 57 feet.

Gray and red tills associated with Des Moines and Superior lobes. Unsorted material with variable texture containing clay sizes and boulders. Sometimes underlain by thin layer of alluvium. Contains sand lenses. Absent in many places, up to 20' thick.

Greenish-gray to olive-gray claystone, fissile, fossiliferous, contains several limestone layers. Patchy in this area. Thicknesses range up to 50'.

Carimona member - micrite, fossiliferous, often fractured and weathered, 3.5-4.5' thick.
Magnolia member - fossiliferous micrite, calcitic shale, with rippled bedding, corroded zones, some fractures. 8.5-9' thick.
Hidden Falls - micrite, shaly, fossiliferous, 6-7' thick.
Mifflin member, thin beds of limestone, interbedded shale 12-13' thick.
Pecatonica member - dolomite, hard, 1-1.5' thick.
Glenwood shale - green shale, sandy at the base, 3-5' thick.

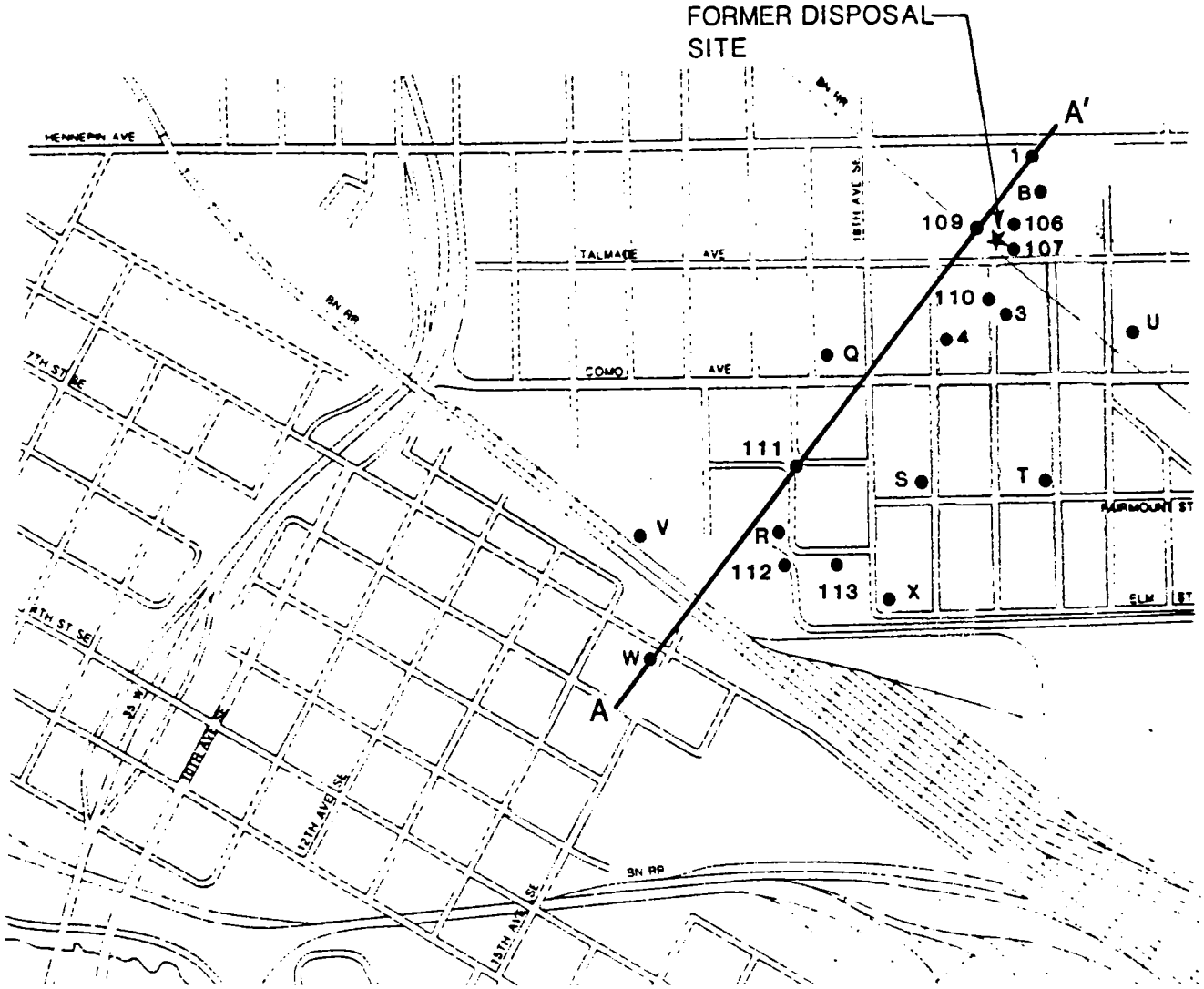
Light yellow or white, medium grained, massive appearing sandstone composed of rounded and subrounded grains. Thin beds of green shale are present. Ranges in thickness from 150-170'.

Thickness of entire formation is 120'-150'.
Willow River Dolomite - thin to thick bedded dolomite, sandy dolomite with some interbedded quartzose sandstone.
New Richmond Sandstone - fine- to medium-grained quartzose sandstone and quartzitic dolomite, minor amounts of shale and pure dolomite.
Oneota Dolomite - thin to thick bedded, light brownish gray or buff, fine- to medium-grained dolomite, silt sized dolomite matrix.

Argillaceous and dolomitic quartz sandstone with pebble-size clasts of dolomitic sandstone and thin beds of dolomite, white or yellow, coarse to medium-grained orthoquartzites to yellow, silty, fine grained quartzose sandstone. 85-100' thick. Underlain by the St. Lawrence Formation which is 120'-200' thick and contains a variety of silty or sandy dolomitic rocks.

Figure 2

GENERALIZED GEOLOGIC COLUMN



● GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

A–A′ CROSS SECTION

N

0 1000

Scale in Feet

Figure 3

1990 MONITORING LOCATIONS
GLACIAL DRIFT

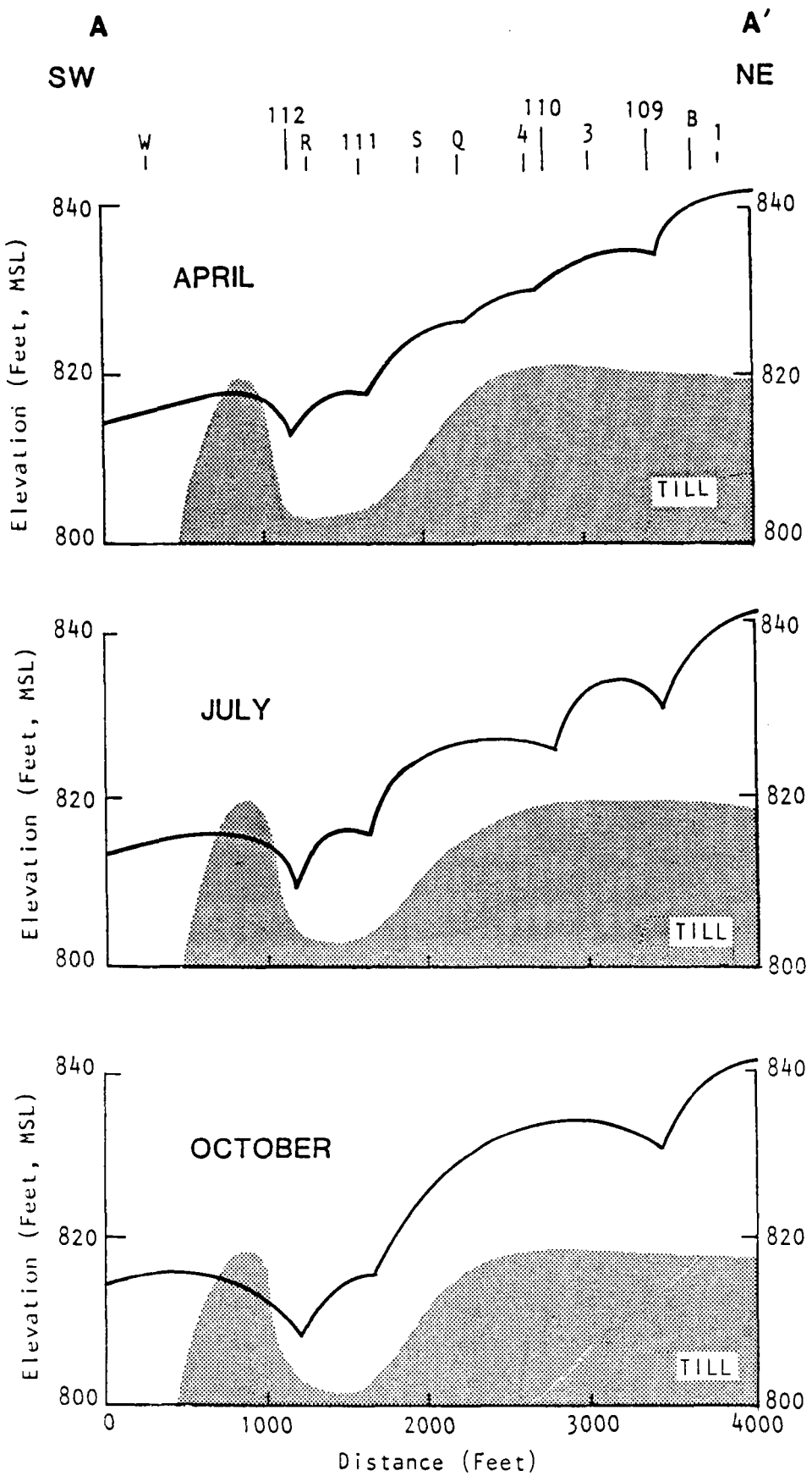
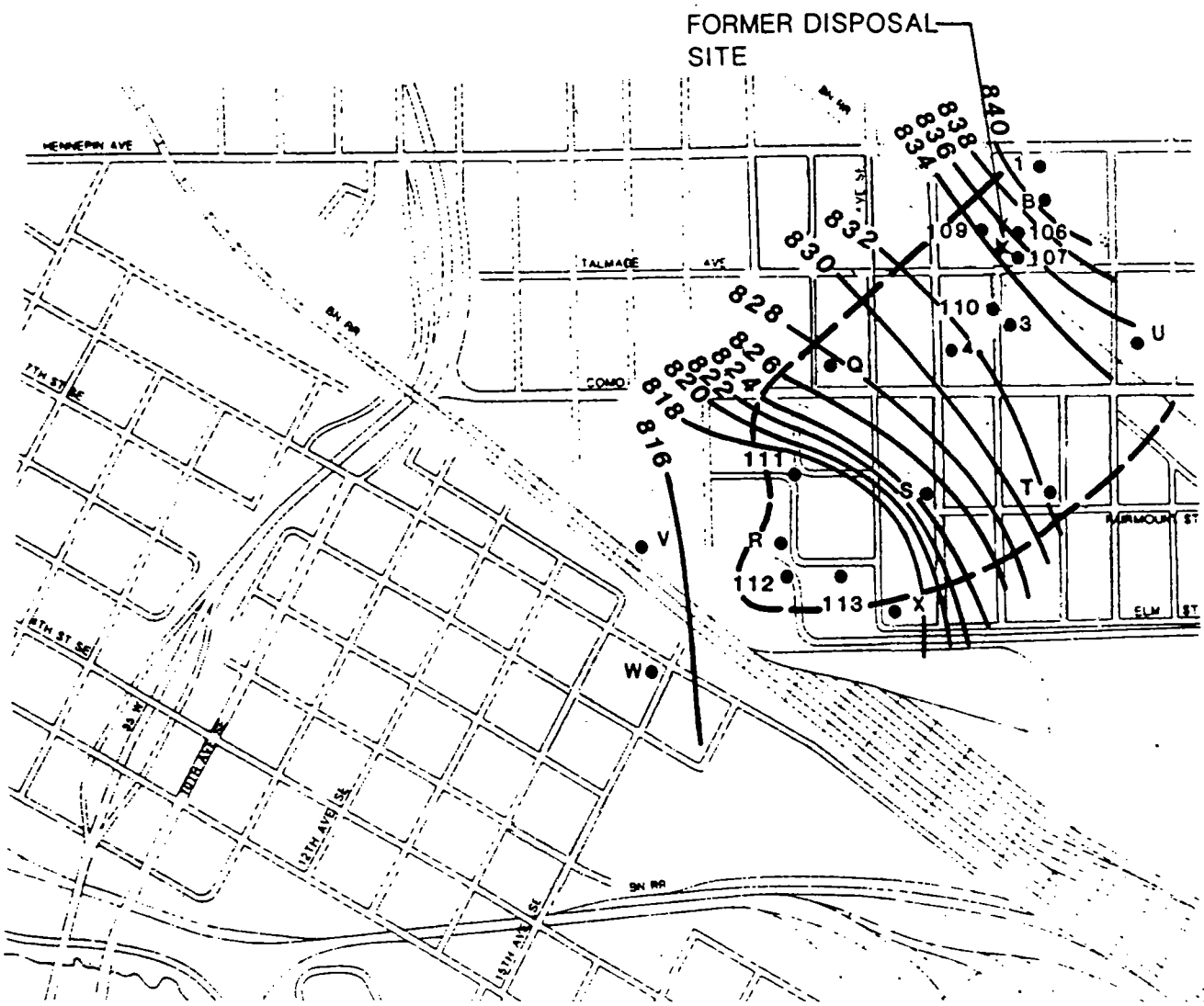


Figure 4

CROSS SECTION A-A'
GLACIAL DRIFT WATER TABLE ELEVATIONS
April, July, October 1989



● GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

——— WATER TABLE CONTOUR (MSL)

— — — ESTIMATED CAPTURE ZONE

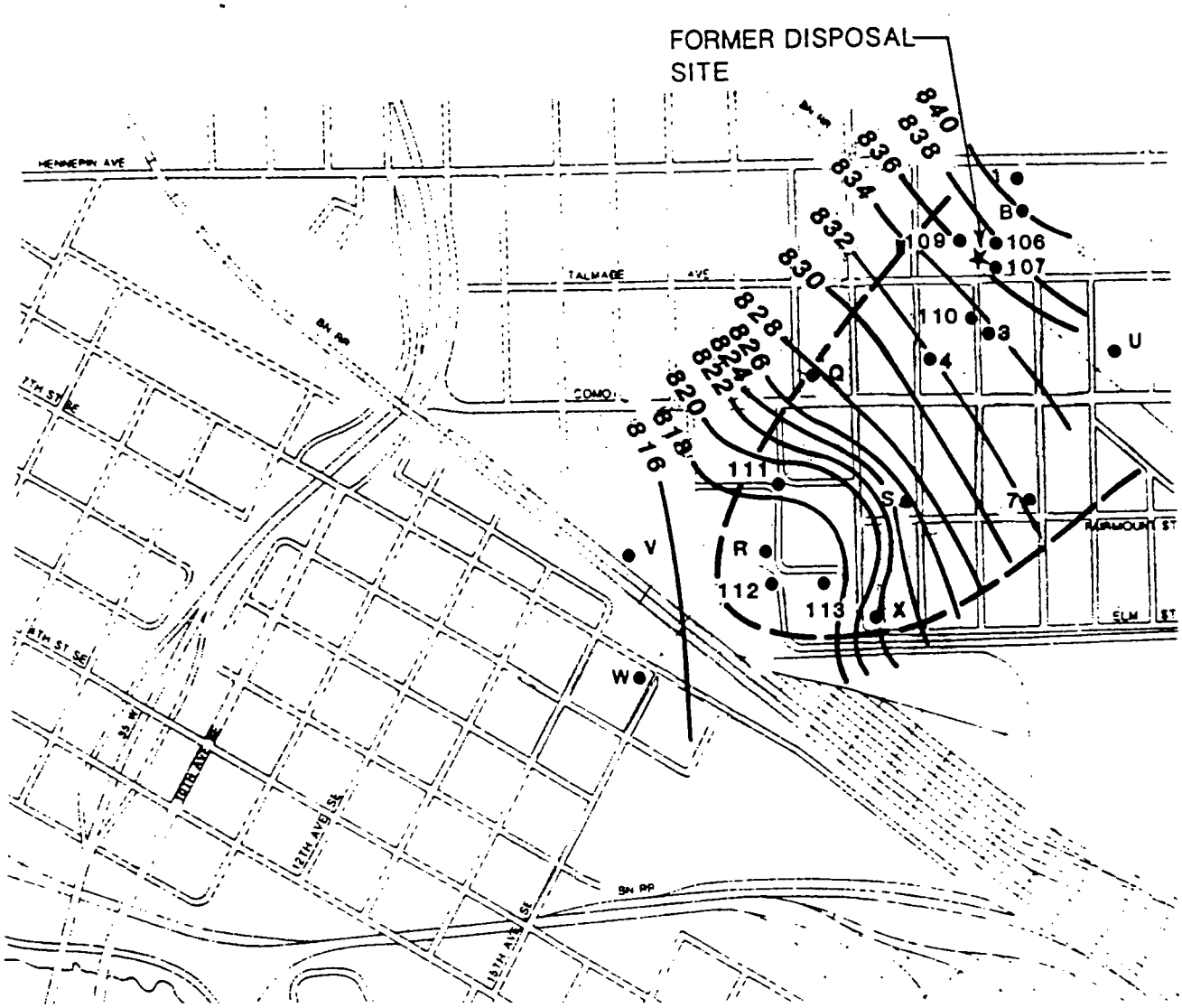
N

0 1000

Scale in Feet

Figure 5

GLACIAL DRIFT AQUIFER
WATER TABLE ELEVATION
April 1989



● GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

WATER TABLE CONTOUR (MSL)

ESTIMATED CAPTURE ZONE

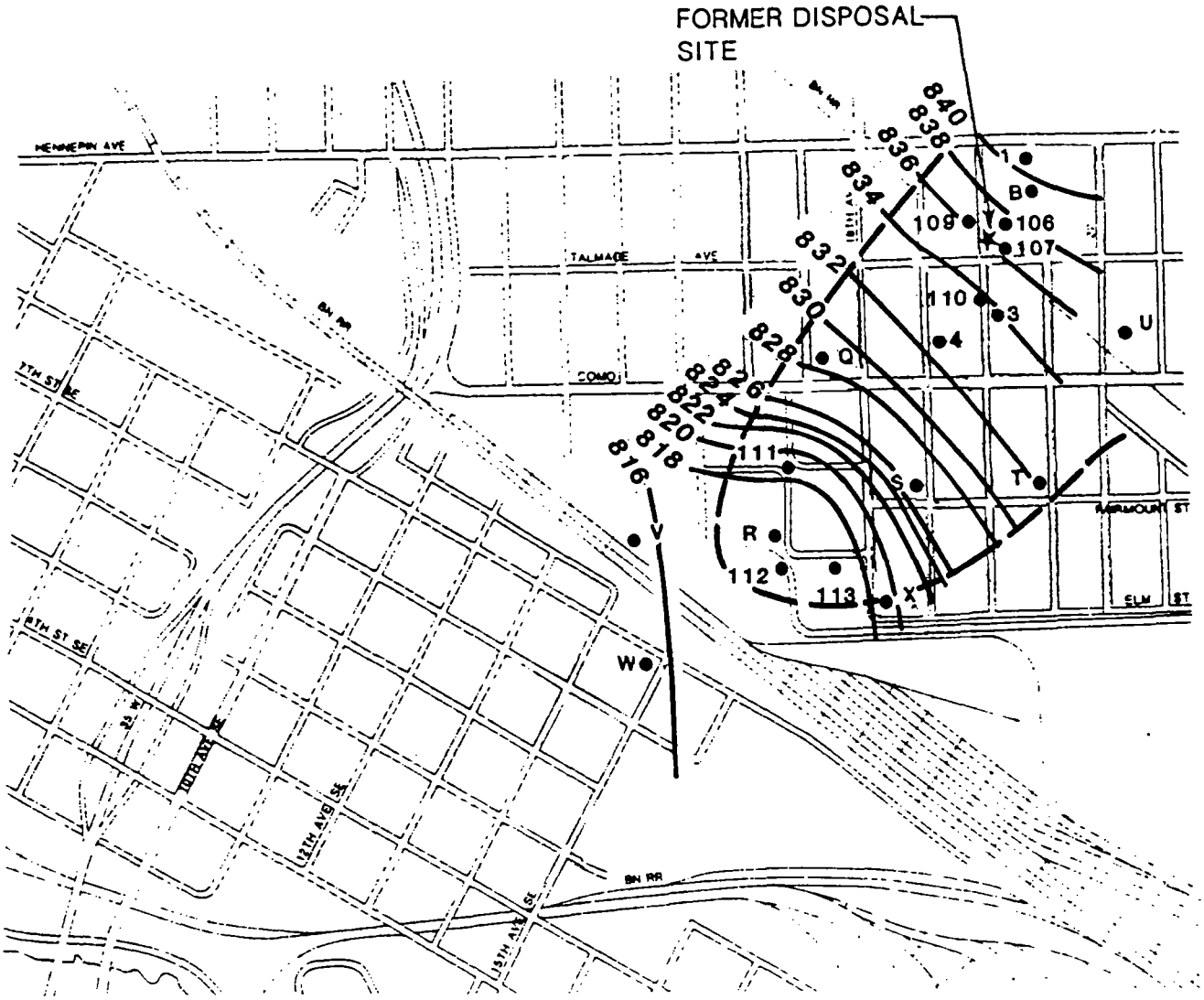
N

0 1000

Scale in Feet

Figure 6

GLACIAL DRIFT AQUIFER
WATER TABLE ELEVATION
July 1989



● GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

WATER TABLE CONTOUR (MSL)

ESTIMATED CAPTURE ZONE

N

0 1000

Scale in Feet

Figure 7

GLACIAL DRIFT AQUIFER
WATER TABLE ELEVATION
October 1989

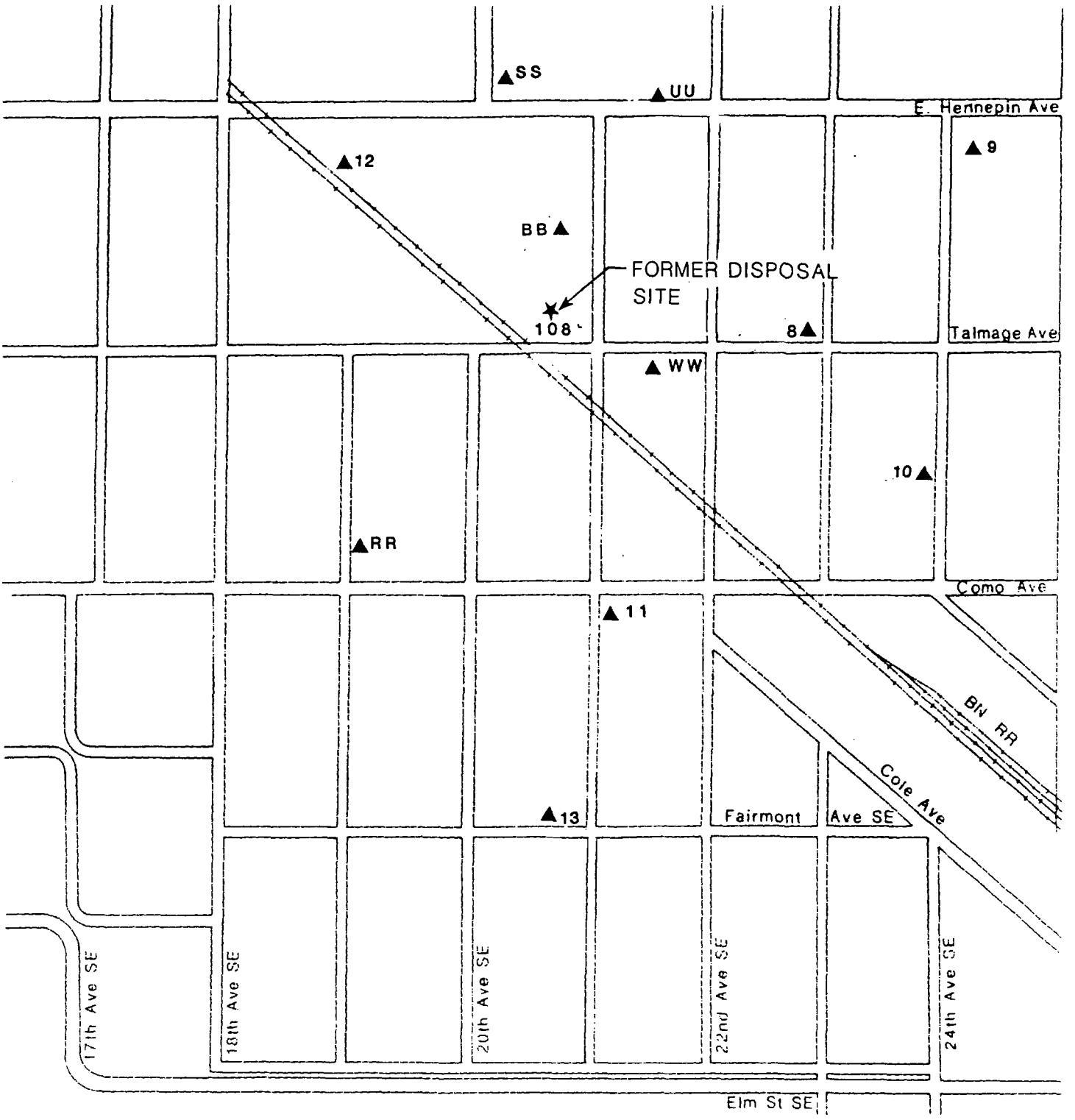
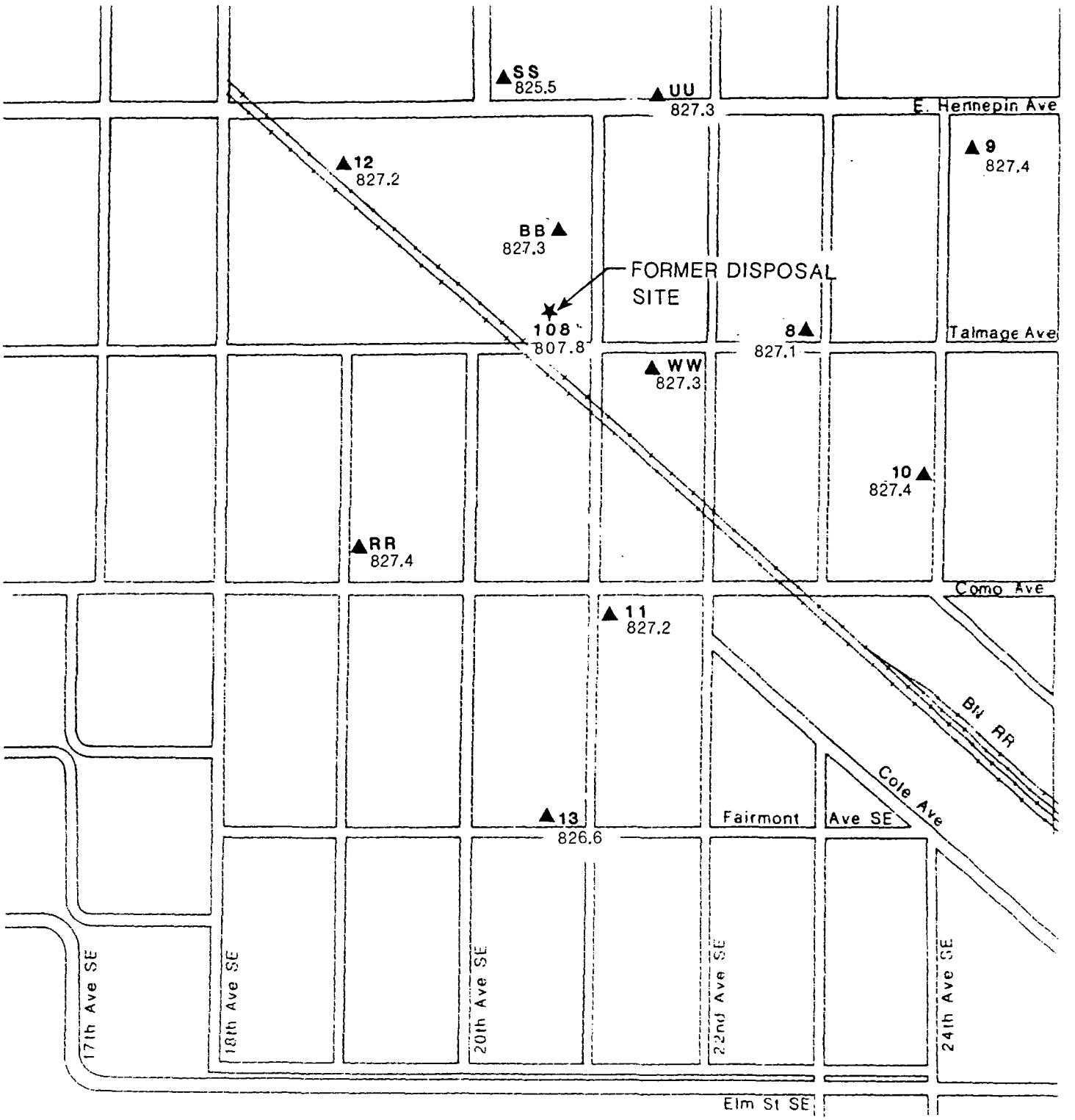


Figure 8

1989 MONITORING LOCATIONS
CARIMONA MEMBER



▲ CARIMONA MEMBER WELL

827.3 CARIMONA POTENTIOMETRIC SURFACE ELEVATION (MSL)

NM NOT MEASURED

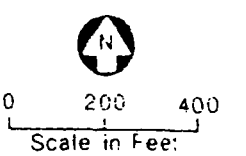
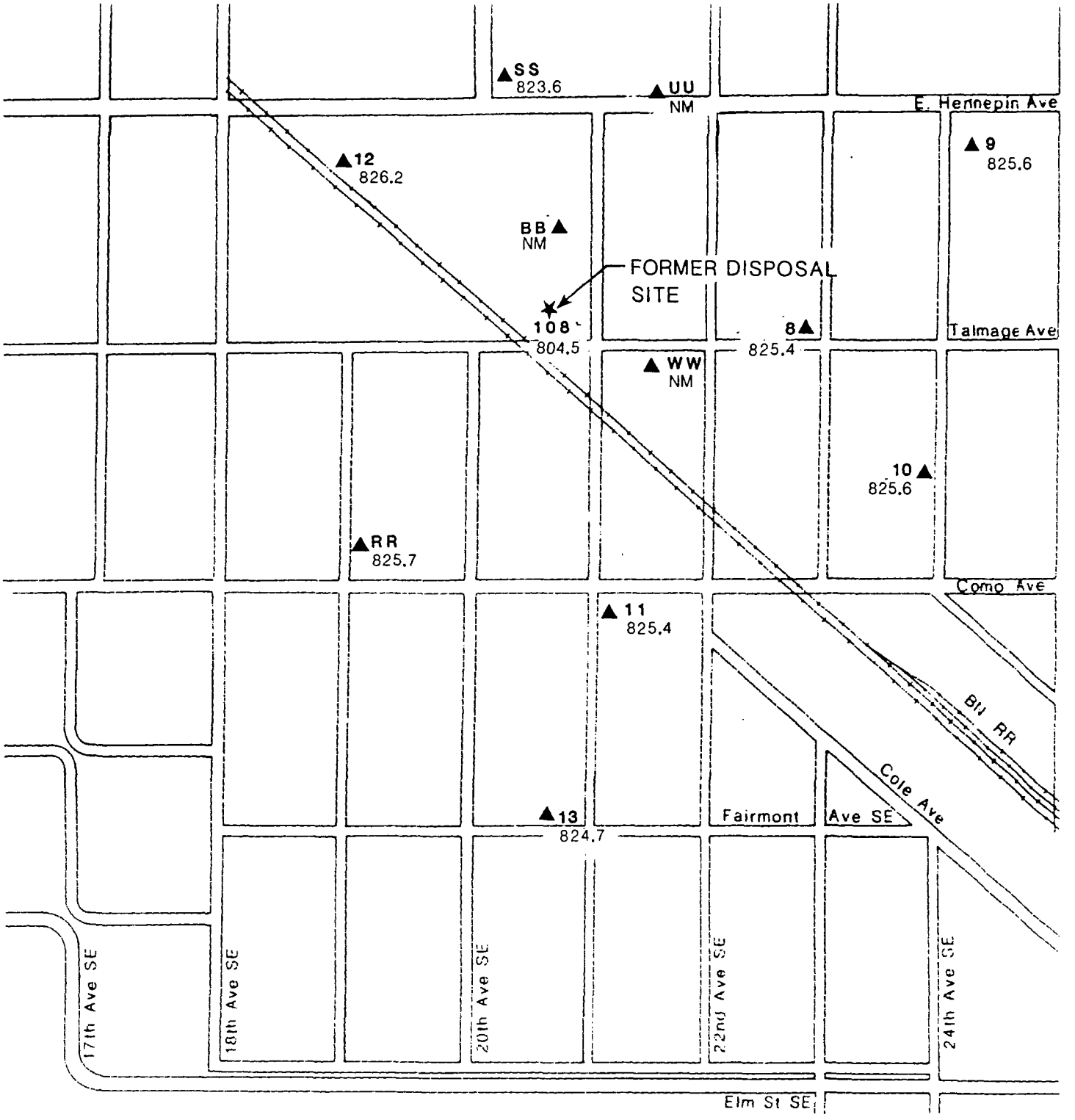


Figure 9

CARIMONA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
April 1989



▲ CARIMONA MEMBER WELL

825.4 CARIMONA POTENTIOMETRIC SURFACE ELEVATION (MSL)

NM NOT MEASURED

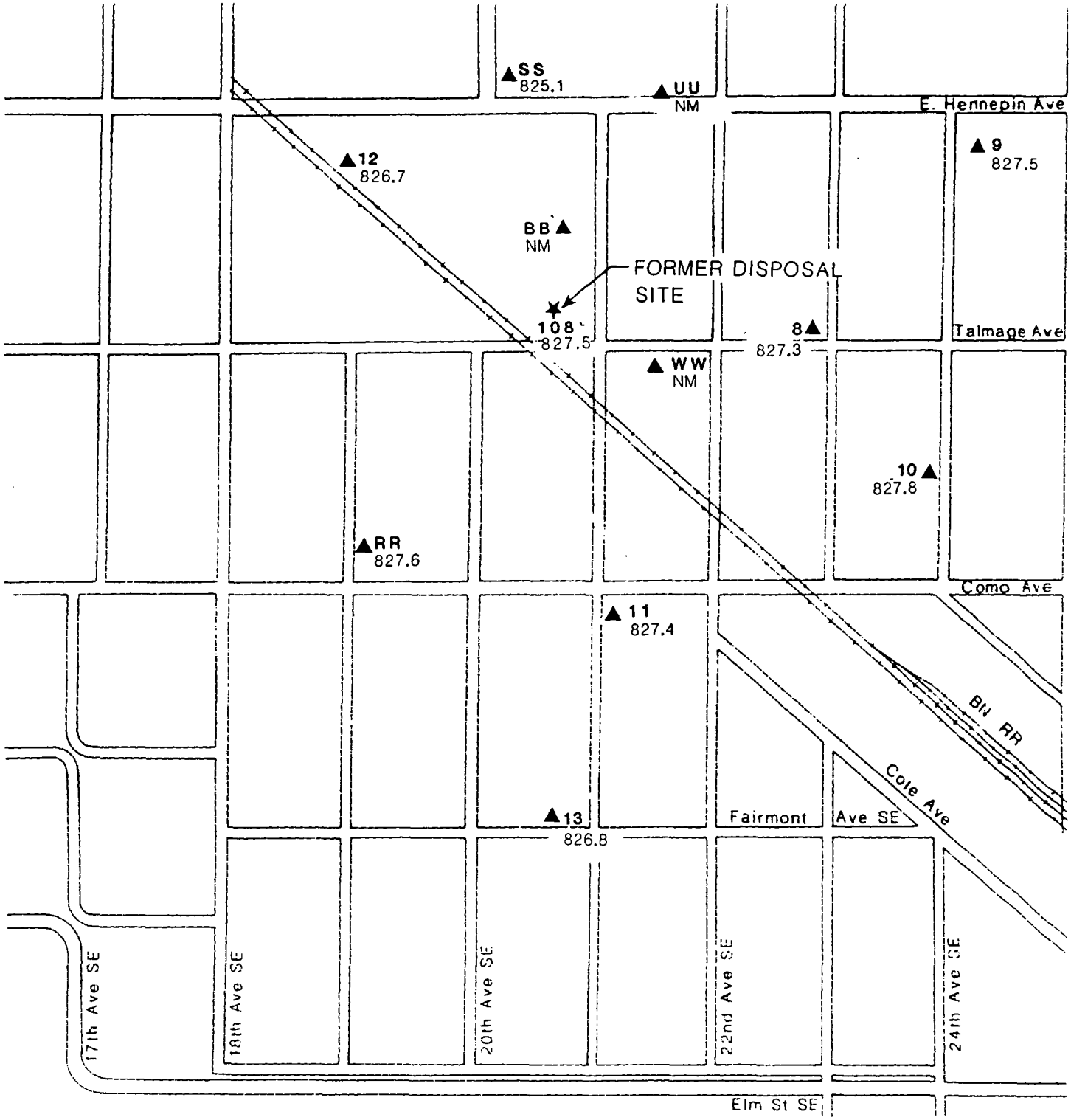
N

0 200 400

Scale in Feet

Figure 10

CARIMONA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
July 1989



▲ CARIMONA MEMBER WELL

827.3 CARIMONA POTENTIOMETRIC SURFACE ELEVATION (MSL)

NM NOT MEASURED

N

0 200 400

Scale in Feet

Figure 11

CARIMONA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
October 1989

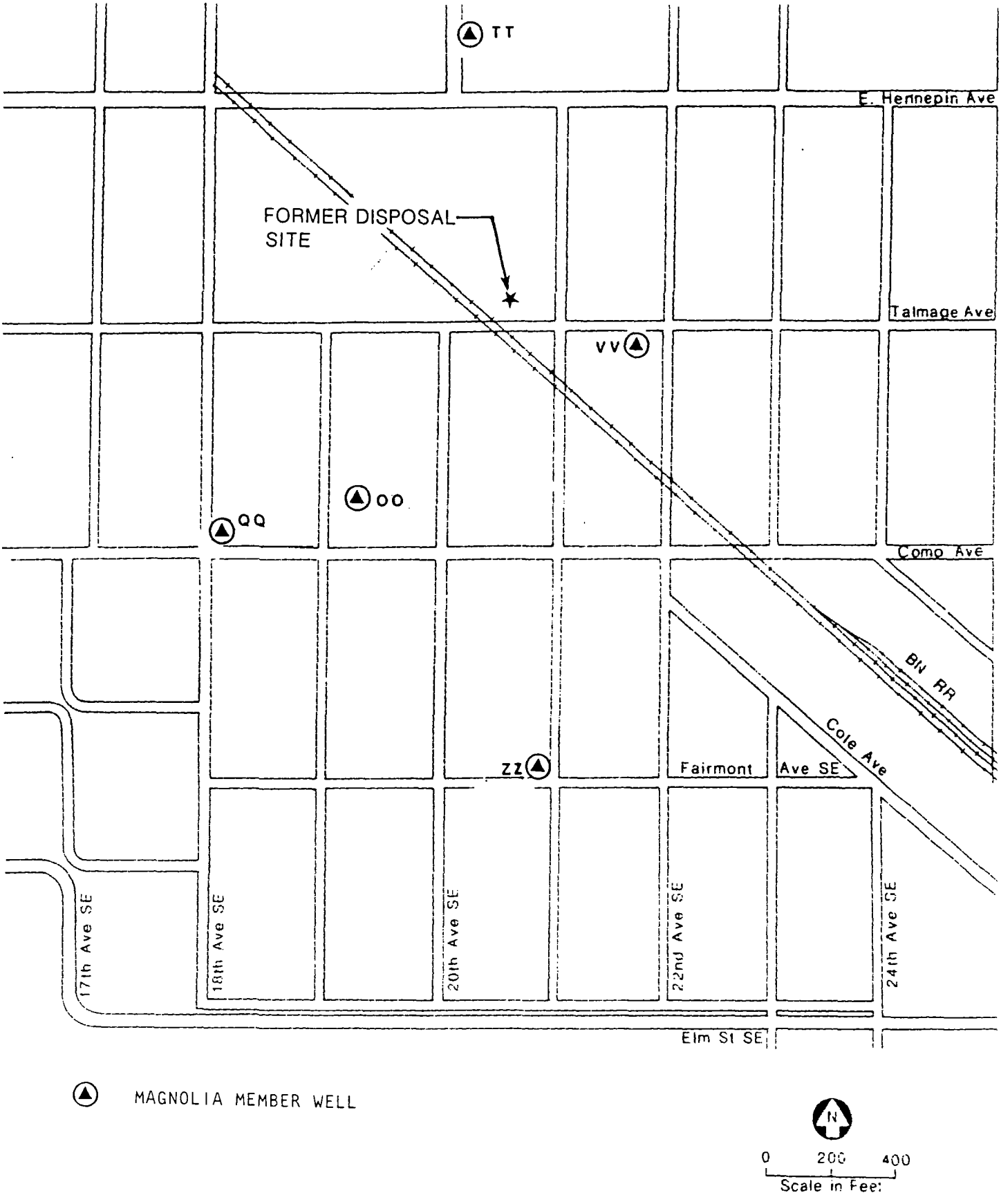


Figure 12

1990 MONITORING LOCATIONS
MAGNOLIA MEMBER

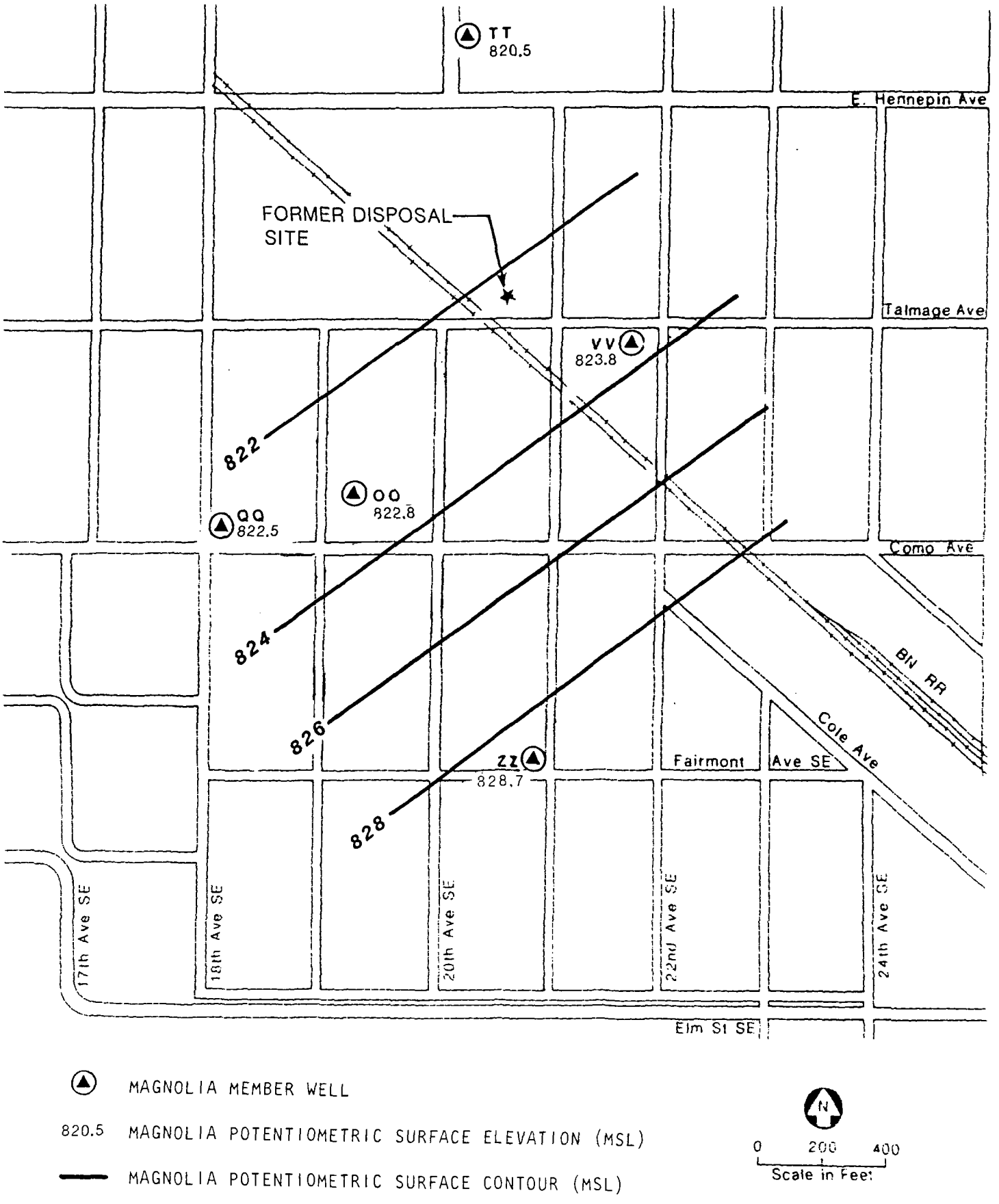


Figure 13

MAGNOLIA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
April 1989

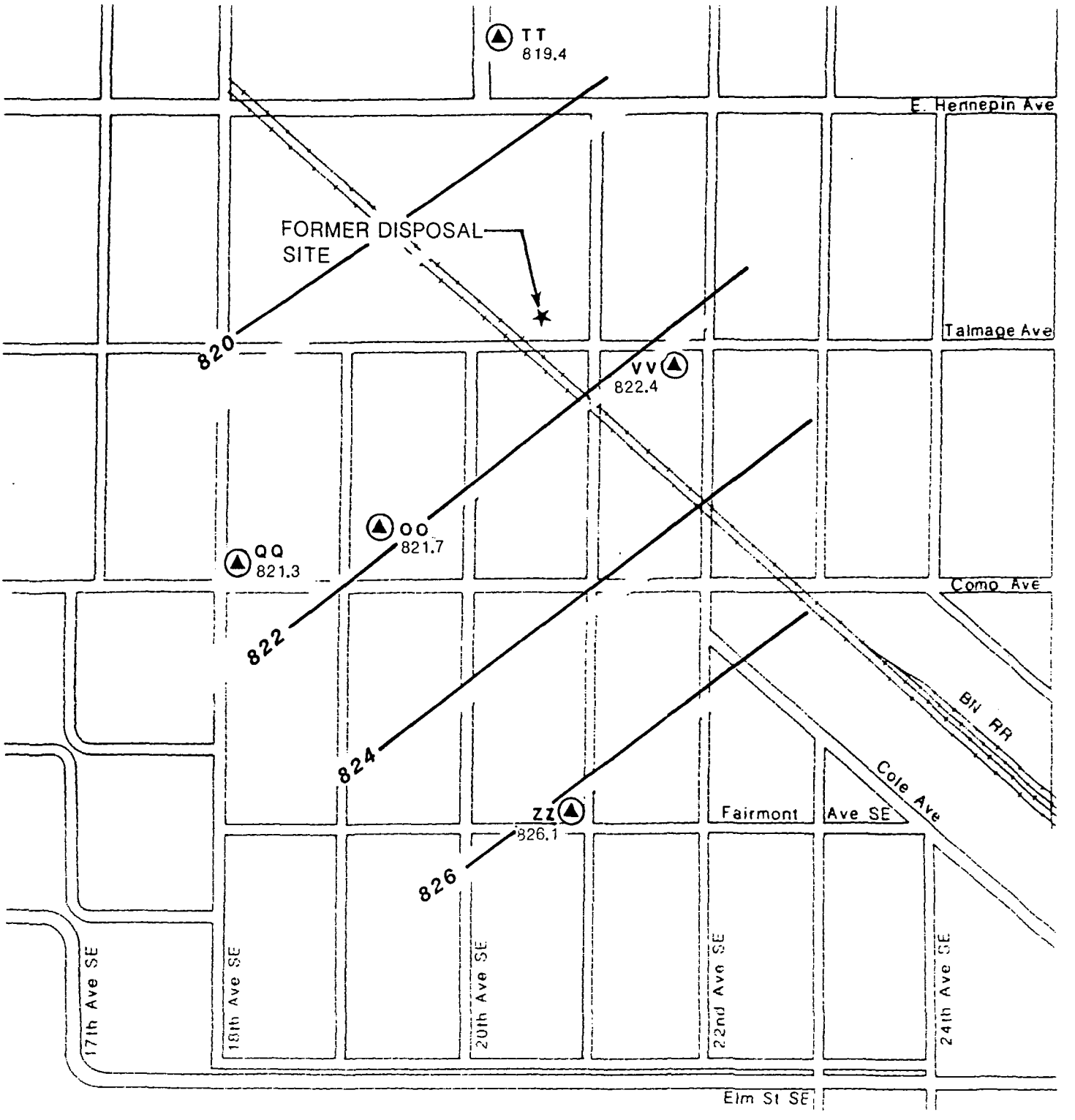


Figure 14

MAGNOLIA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
July 1989

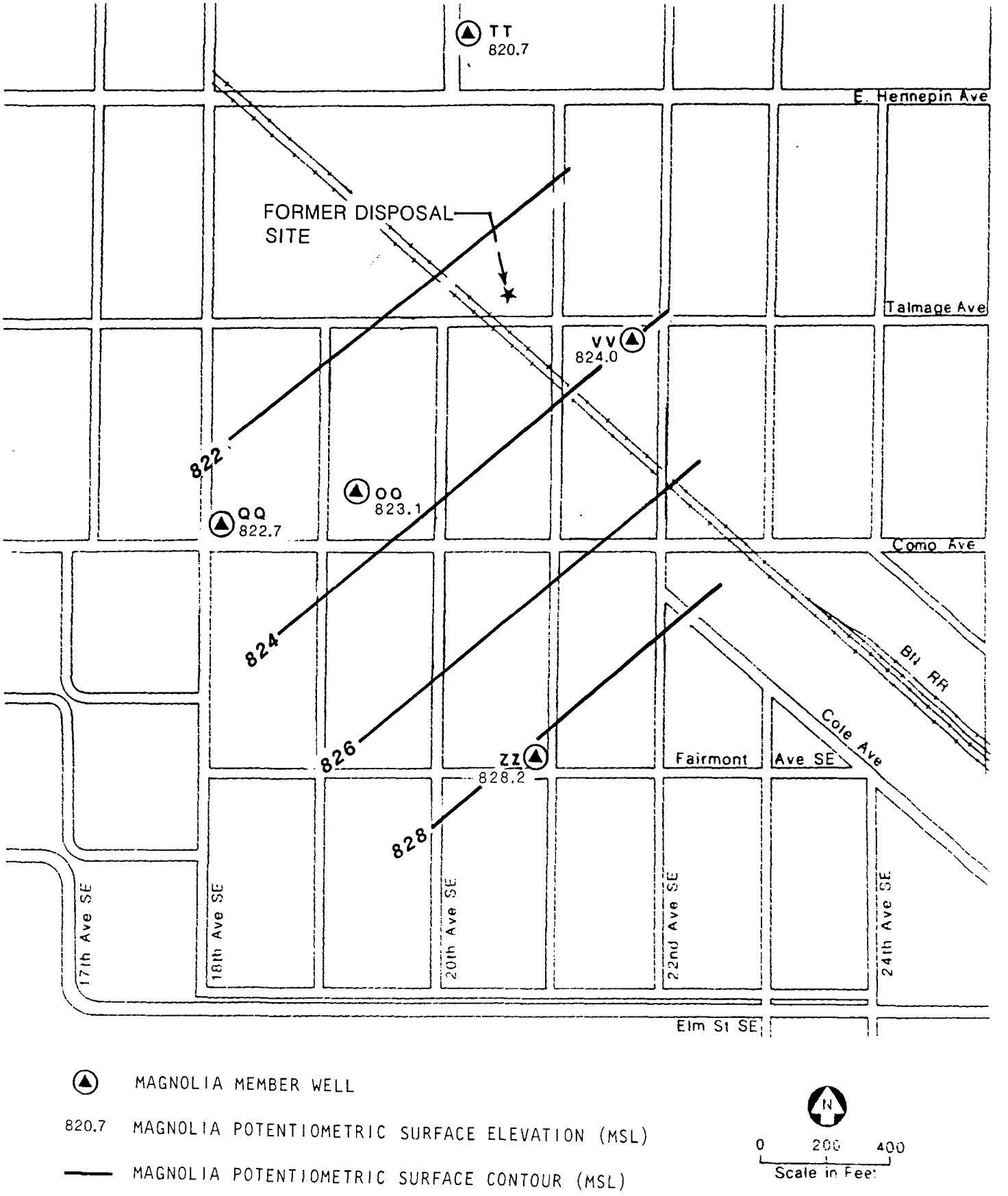


Figure 15

MAGNOLIA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
October 1989

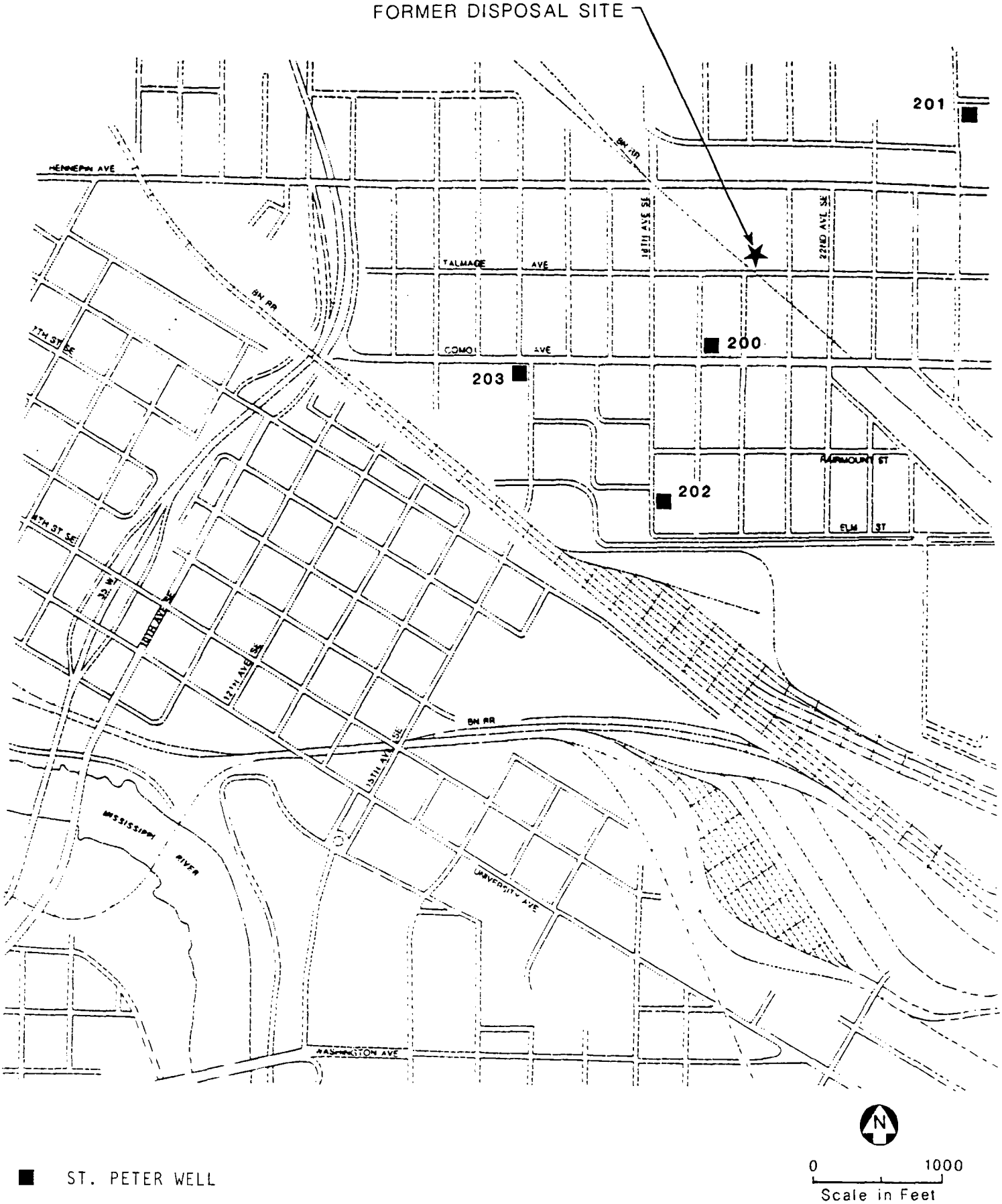
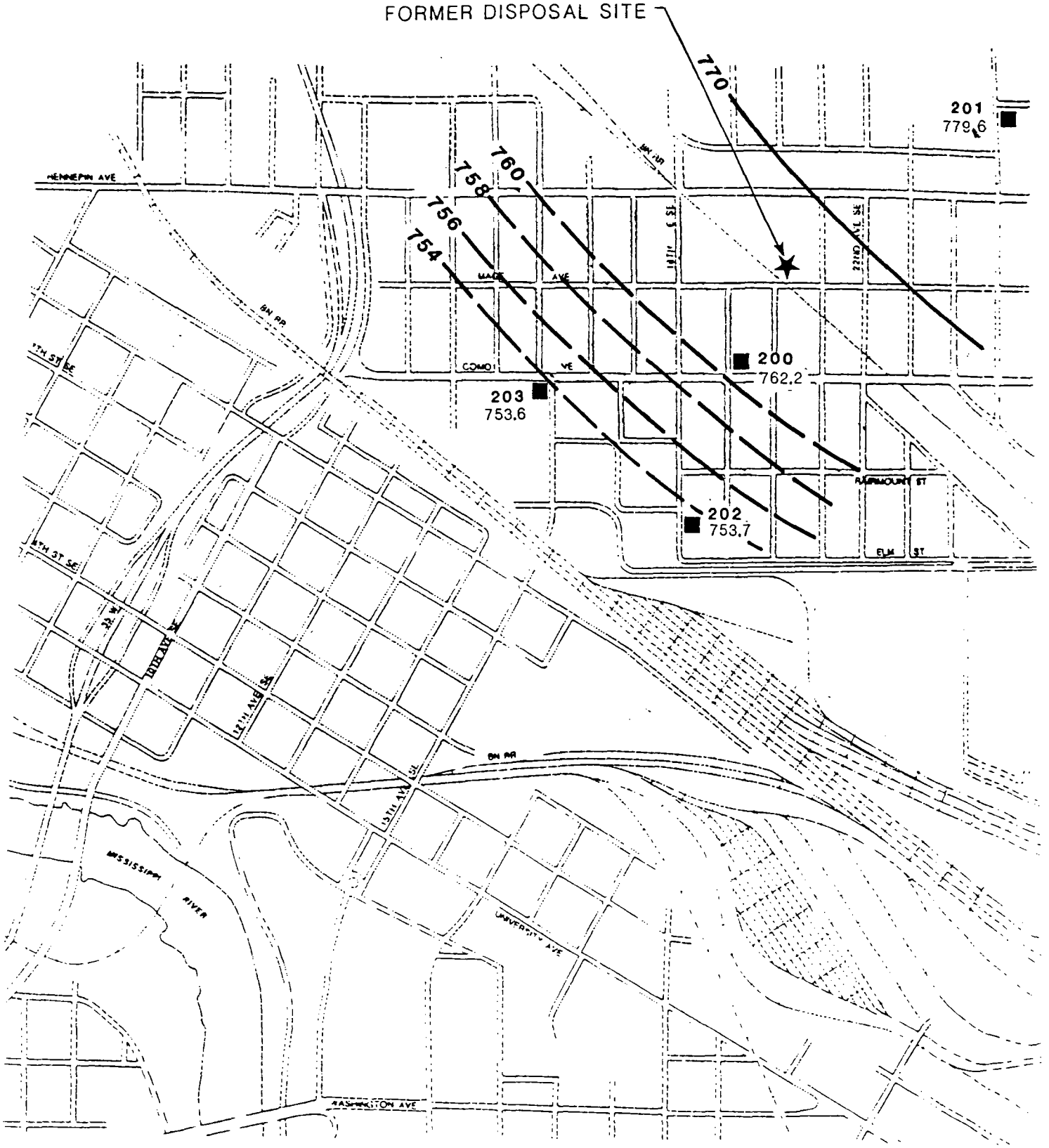


Figure 16

1990 MONITORING LOCATIONS
ST. PETER



■ ST. PETER WELL

762.2 ST. PETER POTENTIOMETRIC SURFACE ELEVATION (MSL)

—— ST. PETER POTENTIOMETRIC SURFACE CONTOUR (MSL)

Figure 17

ST. PETER
POTENTIOMETRIC SURFACE ELEVATION
April 1989

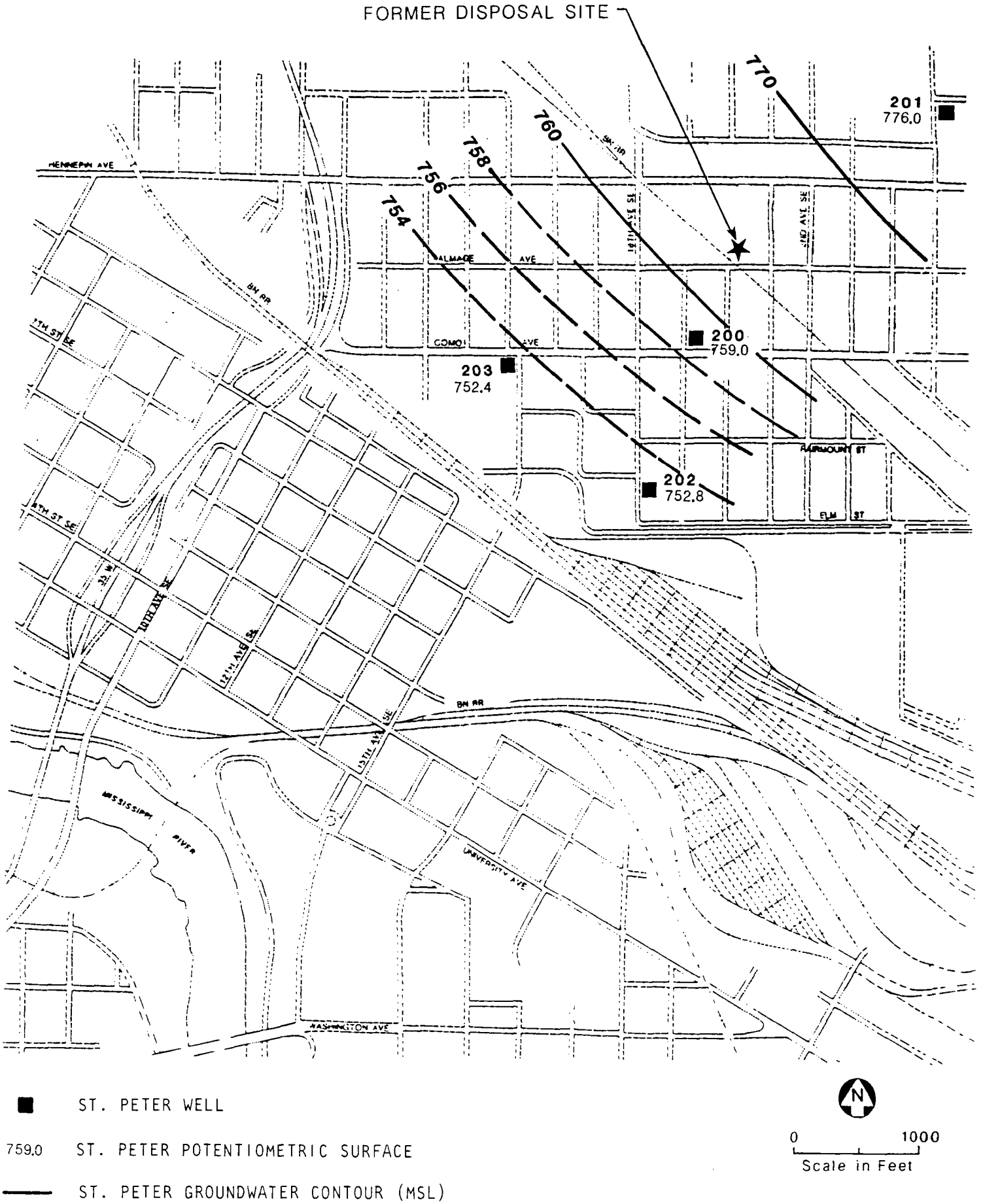


Figure 18

ST. PETER
POTENTIOMETRIC SURFACE ELEVATION
July 1989

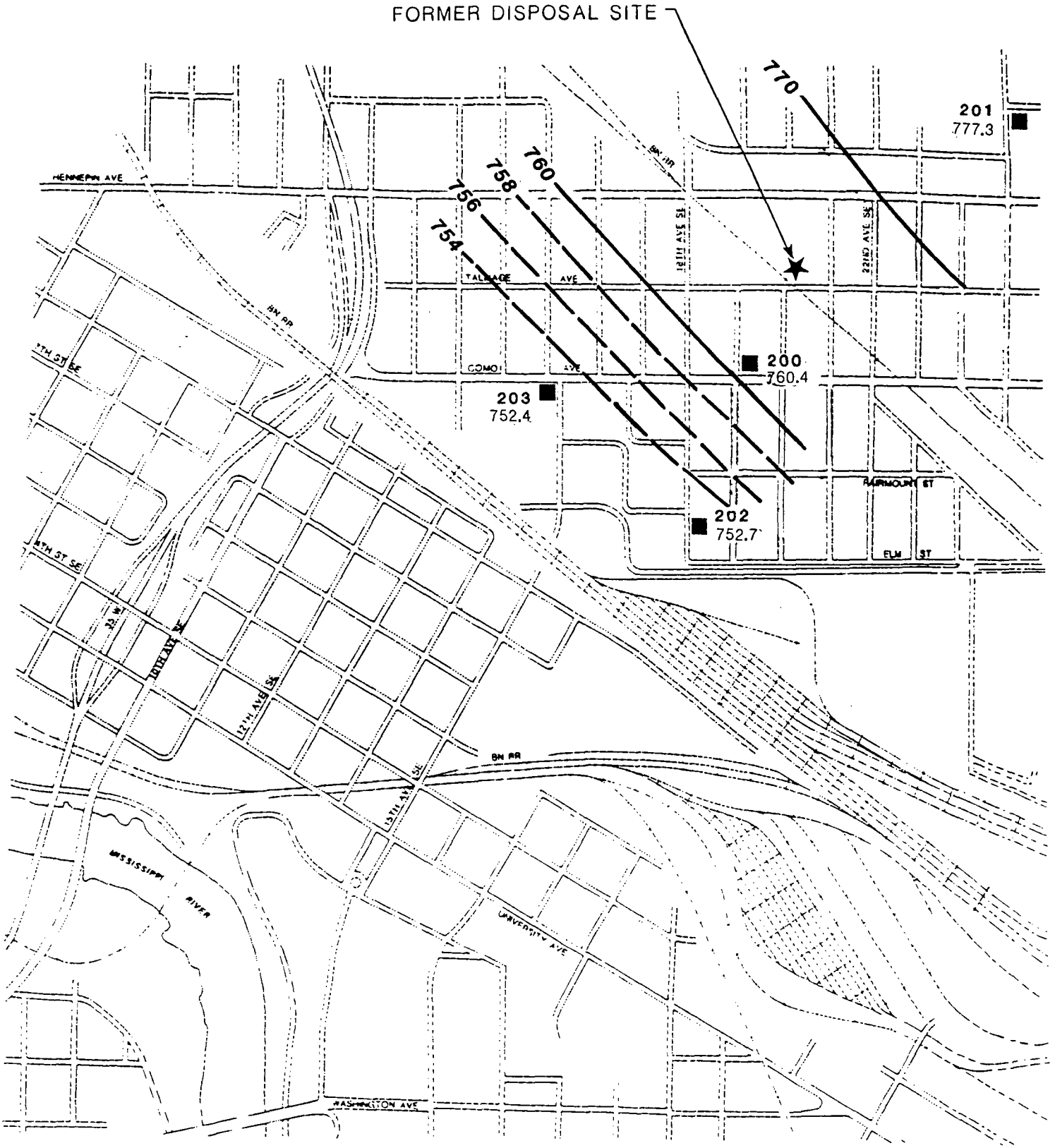
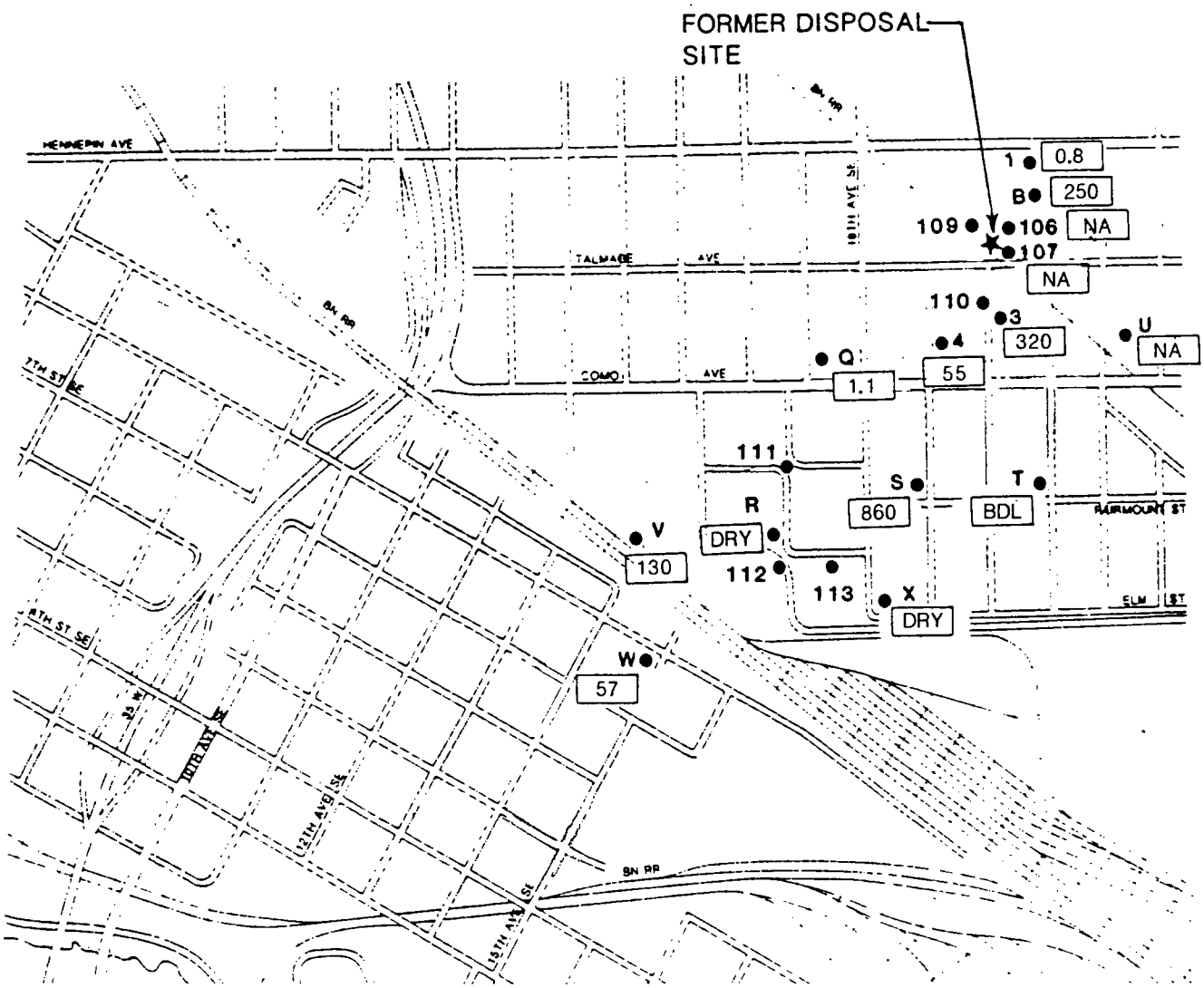


Figure 19

ST. PETER POTENTIOMETRIC SURFACE ELEVATION
October 1989



● GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

320 TRICHLOROETHENE CONCENTRATION (ug/L) (TCE)

BDL BELOW DETECTION LIMIT

NA NOT ANALYZED

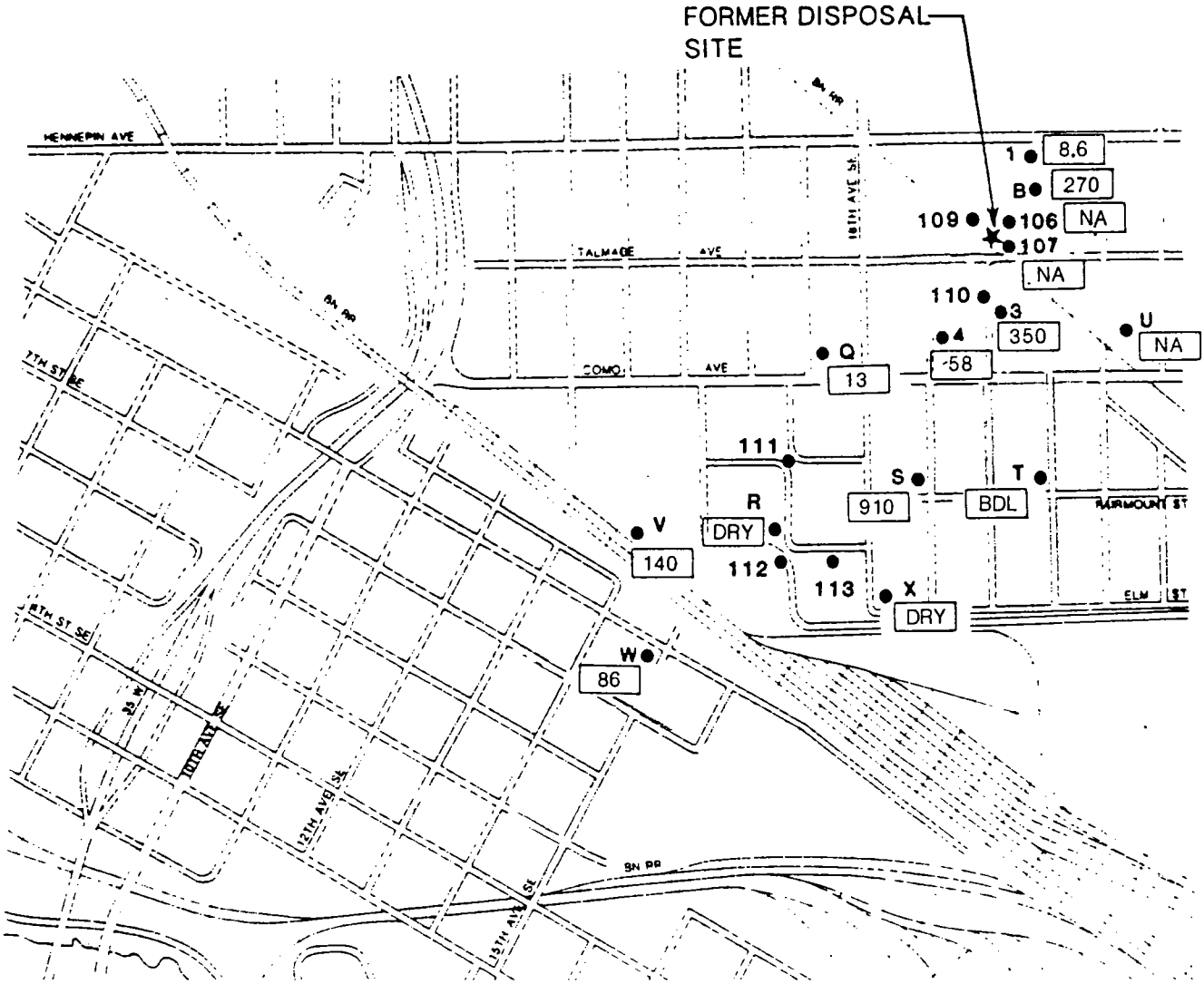
N

0 1000

Scale in Feet

Figure 20

GLACIAL DRIFT AQUIFER
WATER QUALITY (TCE)
April 1989



- GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

350 SUM OF VOLATILE ORGANIC CONCENTRATIONS (ug/L) (VOC)

BDL BELOW DETECTION LIMIT

NA NOT ANALYZED

Figure 21

GLACIAL DRIFT AQUIFER
WATER QUALITY (VOC)
April 1989

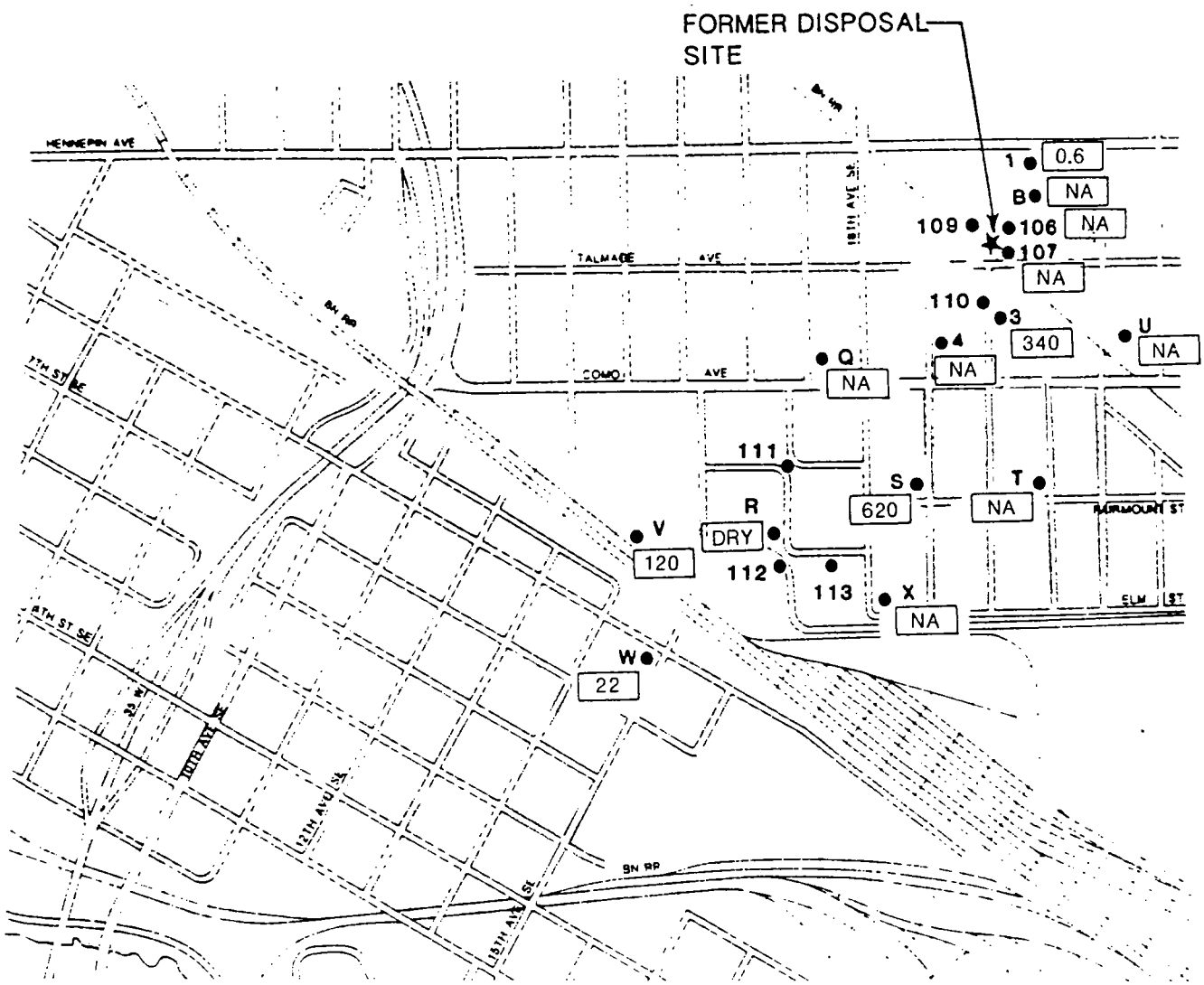
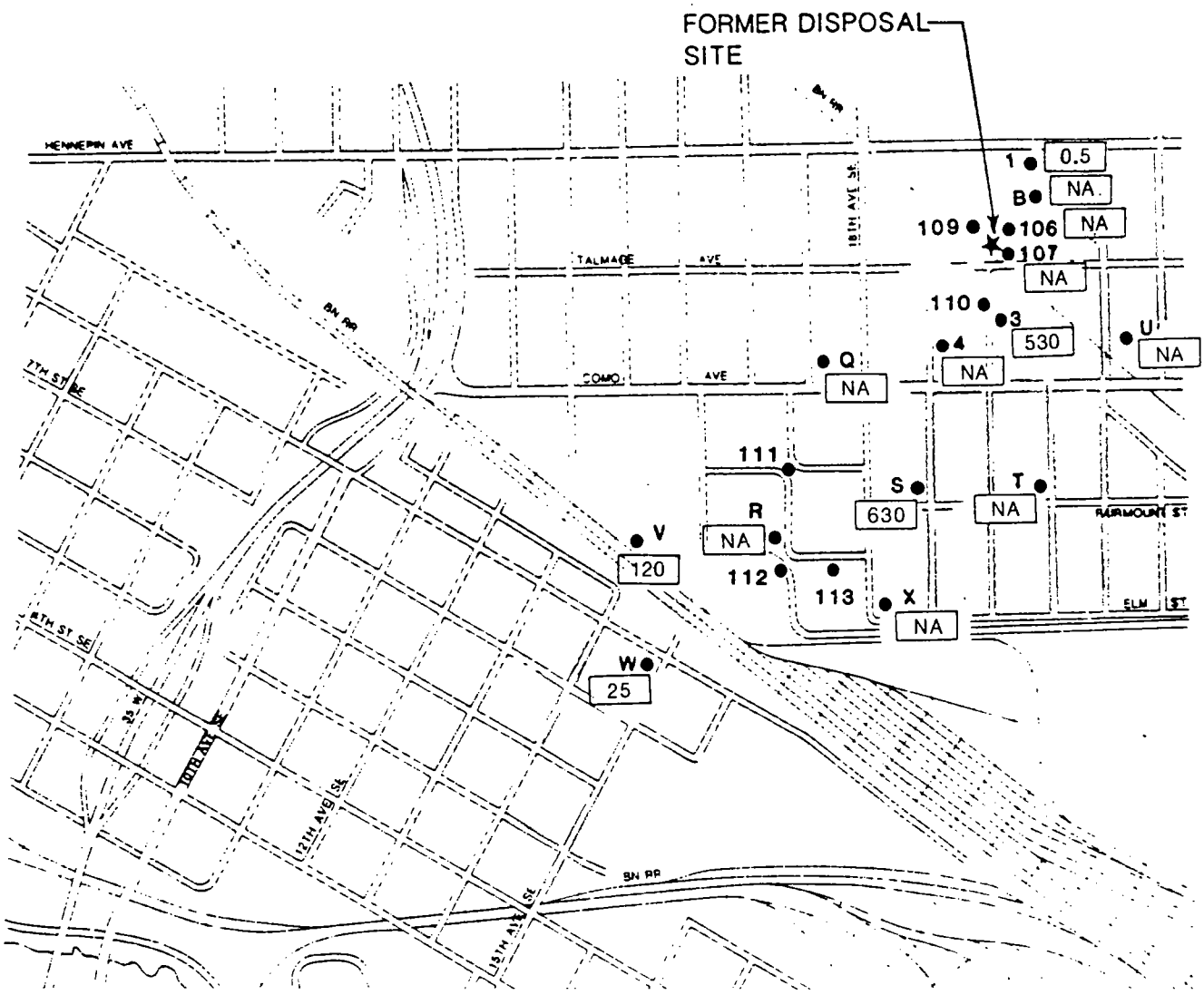


Figure 22

GLACIAL DRIFT AQUIFER
WATER QUALITY (TCE)
July 1989



● GLACIAL DRIFT MONITORING WELL OR SITE AND DOWNGRADIENT PUMP-OUT WELL

530 TRICHLOROETHENE CONCENTRATION (ug/L) (TCE)

NA NOT ANALYZED

BDL BELOW DETECTION LIMIT

N

0 1000

Scale in Feet

Figure 23

GLACIAL DRIFT AQUIFER
WATER QUALITY (TCE)
October 1989

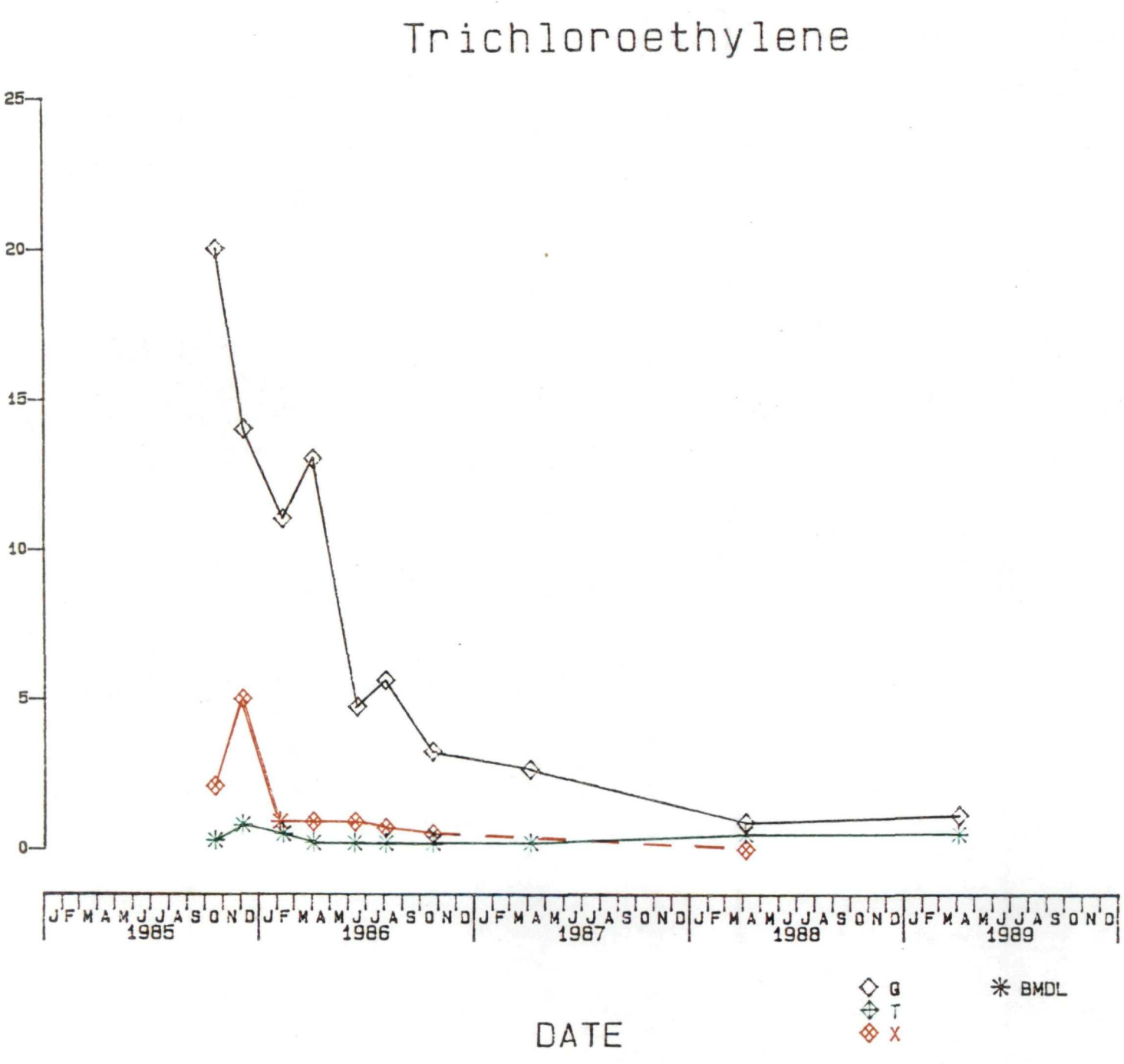


Figure 24
GLACIAL DRIFT WELLS
(TCE VS. TIME)

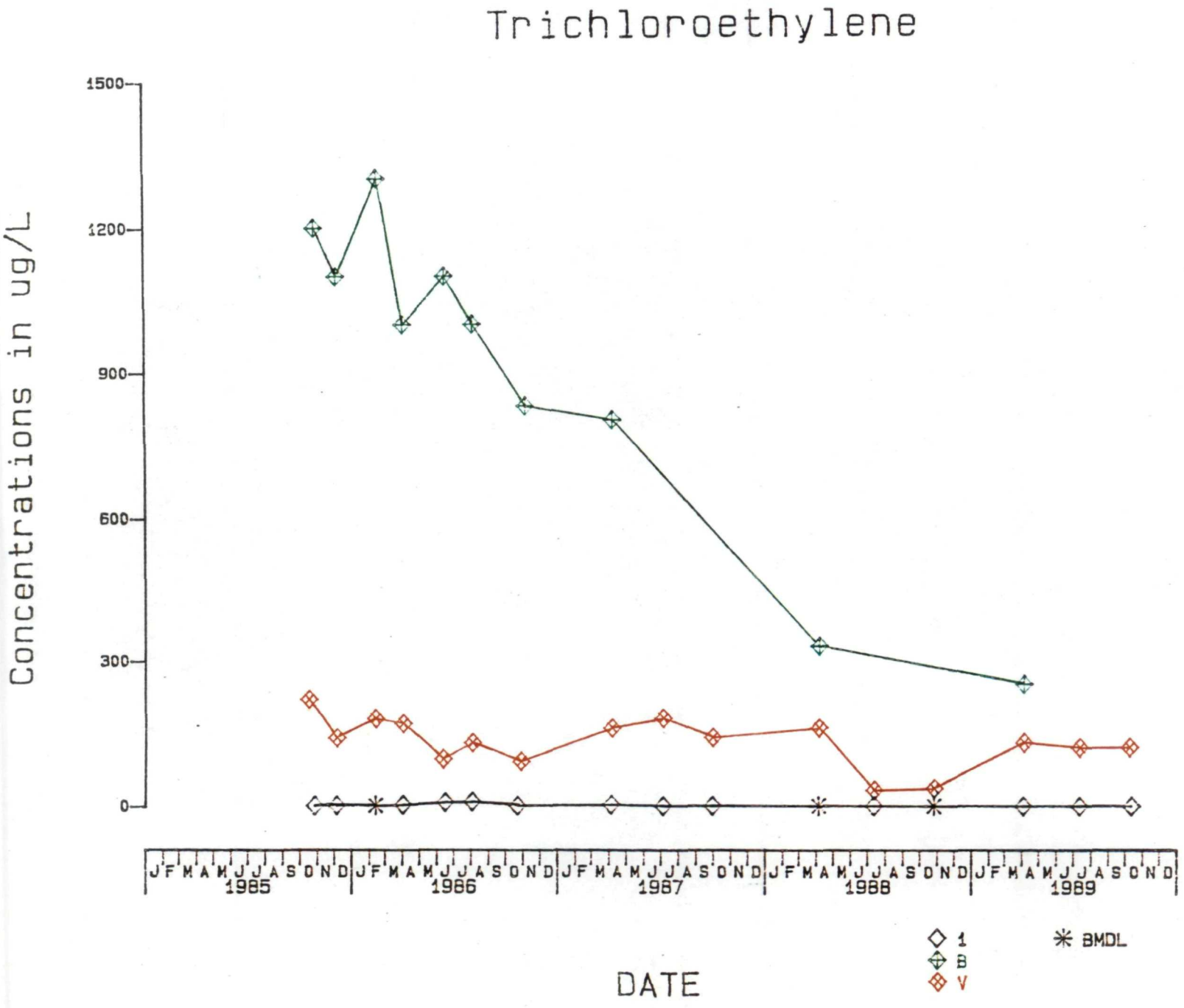


Figure 24 (cont.)
GLACIAL DRIFT WELLS
(TCE VS. TIME)

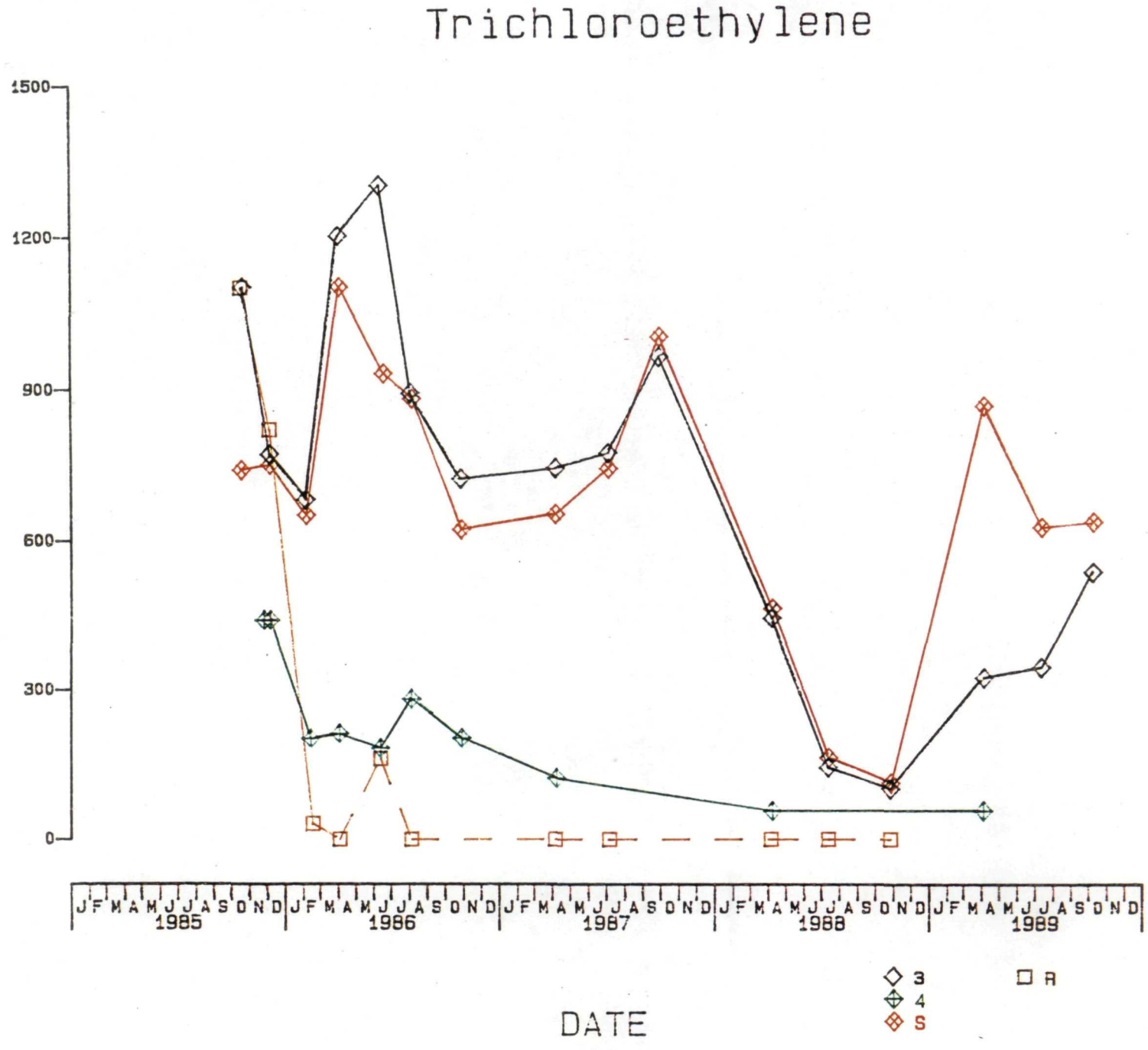
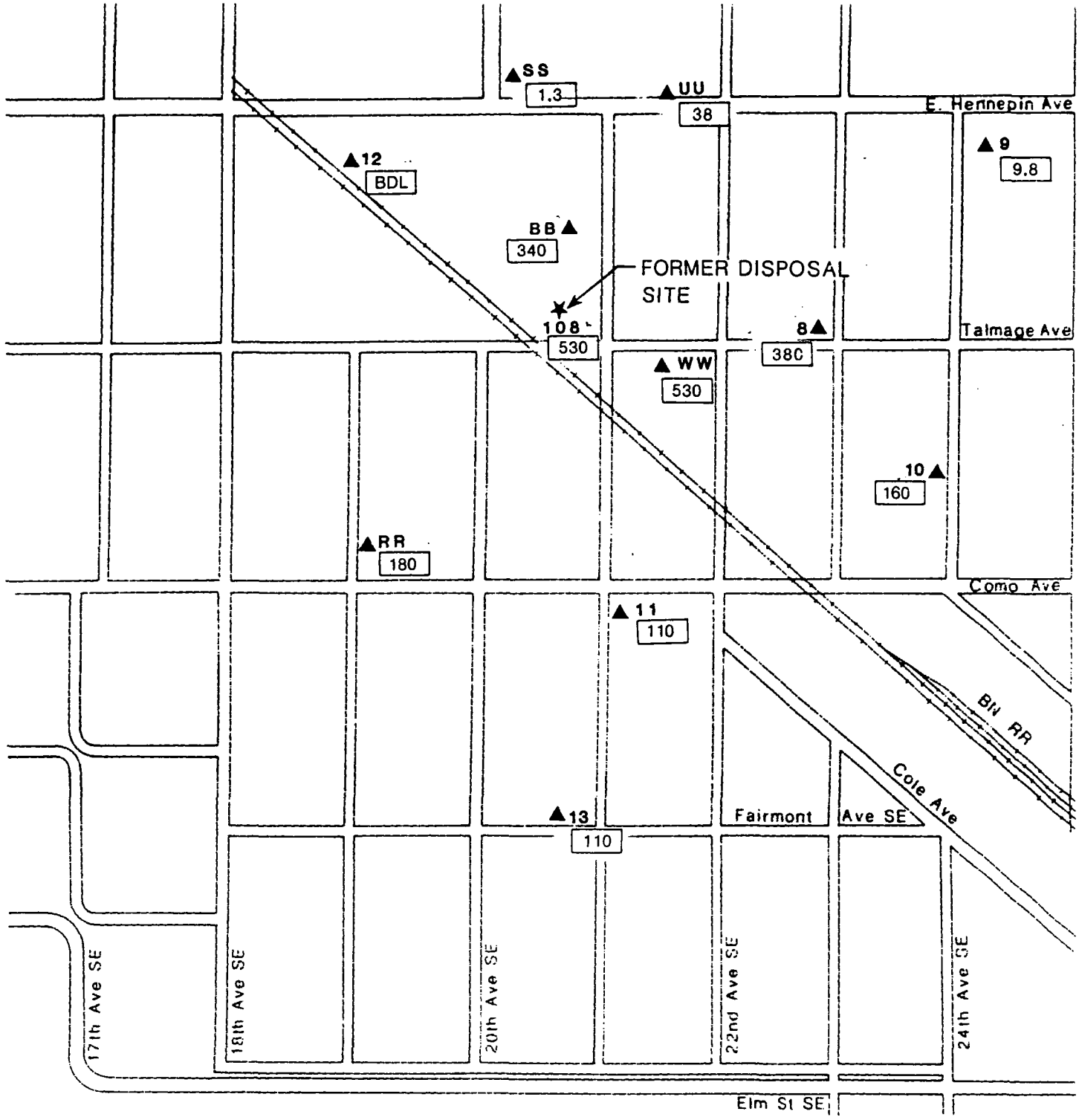


Figure 24 (cont.)
GLACIAL DRIFT WELLS
(TCE VS. TIME)



▲ CARIMONA MEMBER WELL

30 TRICHLOROETHENE CONCENTRATION (ug/L) (TCE)

BDL BELOW DETECTION LIMIT

N

0 200 400

Scale in Feet

Figure 25

CARIMONA MEMBER
WATER QUALITY (TCE)
April 1989

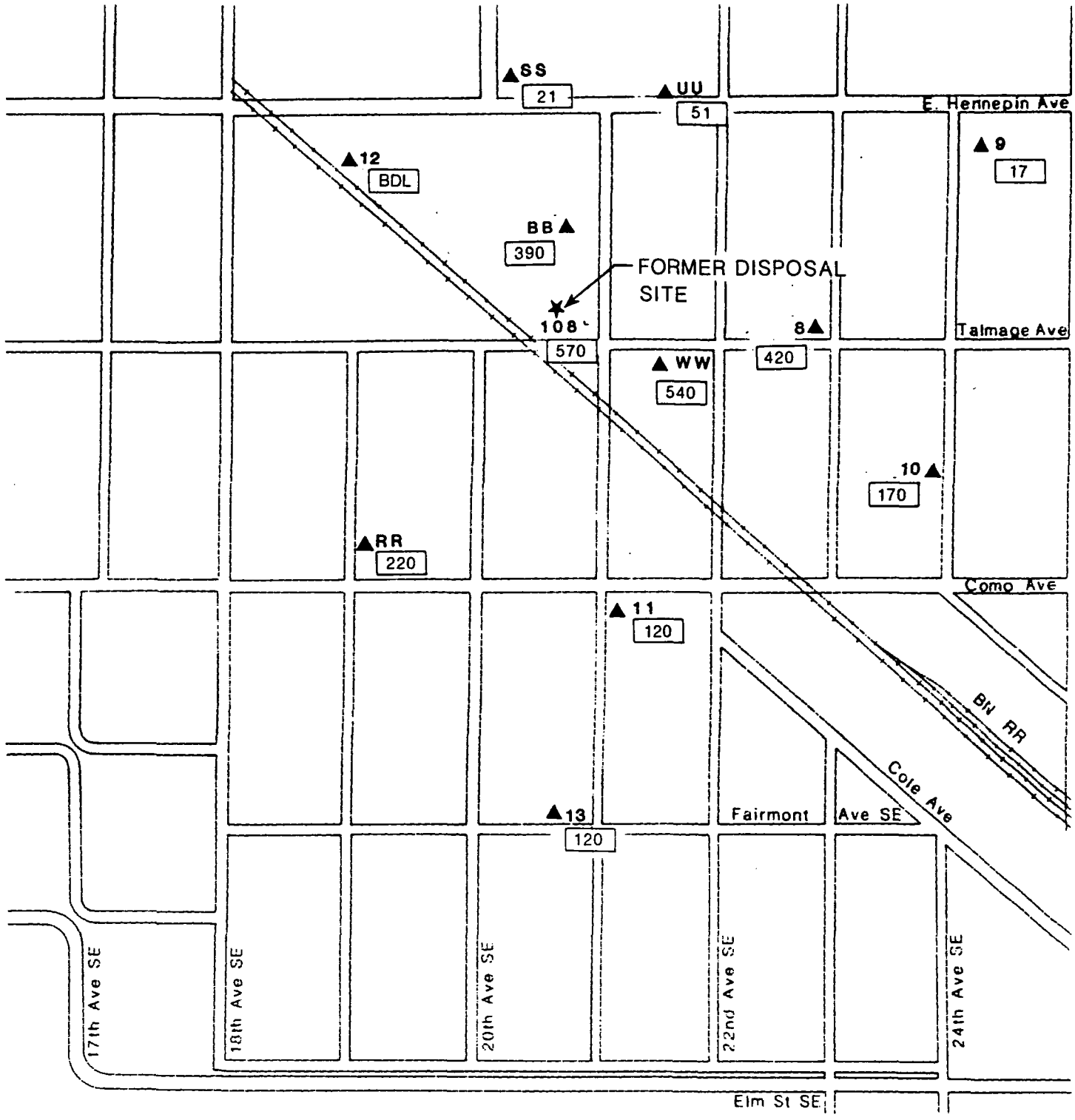


Figure 26

CARIMONA MEMBER
WATER QUALITY (VOC)
April 1989

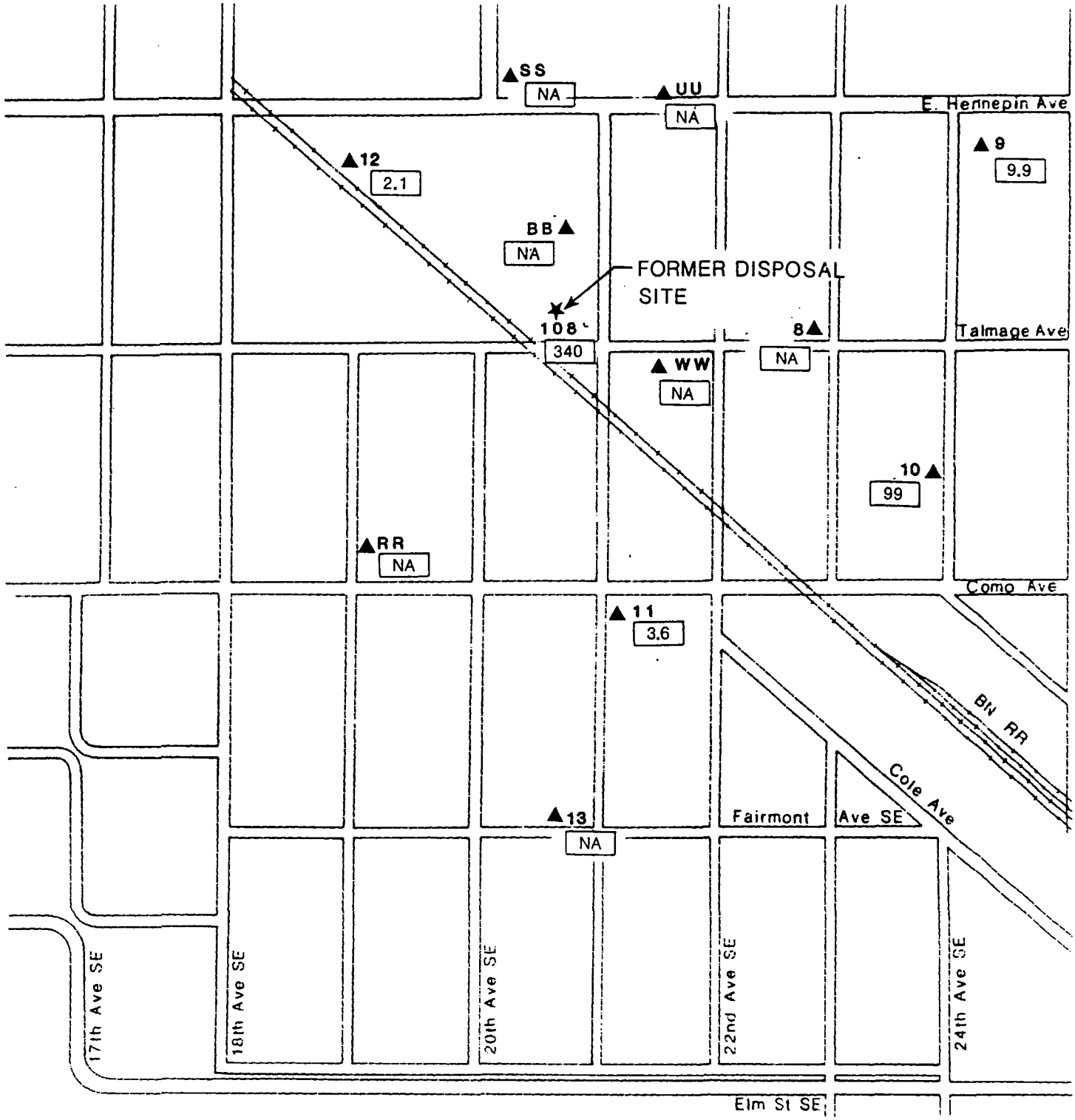
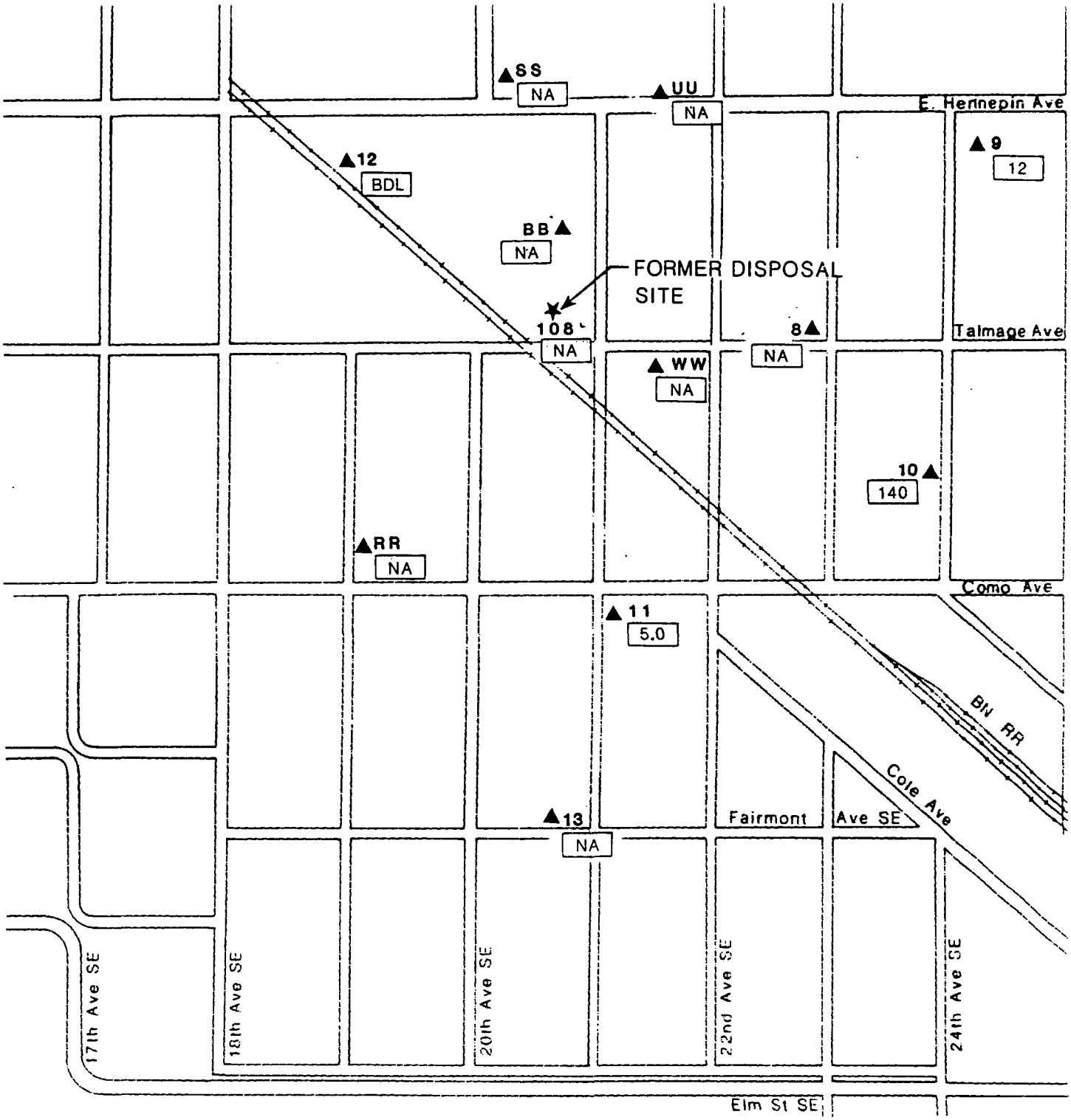


Figure 27

CARIMONA MEMBER
WATER QUALITY (TCE)
July 1989



▲ CARIMONA MEMBER WELL

140 TRICHLOROETHENE CONCENTRATION (ug/L) (TCE)

NA NOT ANALYZED

BDL BELOW DETECTION LIMIT

N

0 200 400

Scale in Feet

Figure 28

CARIMONA MEMBER
WATER QUALITY (TCE)
October 1989

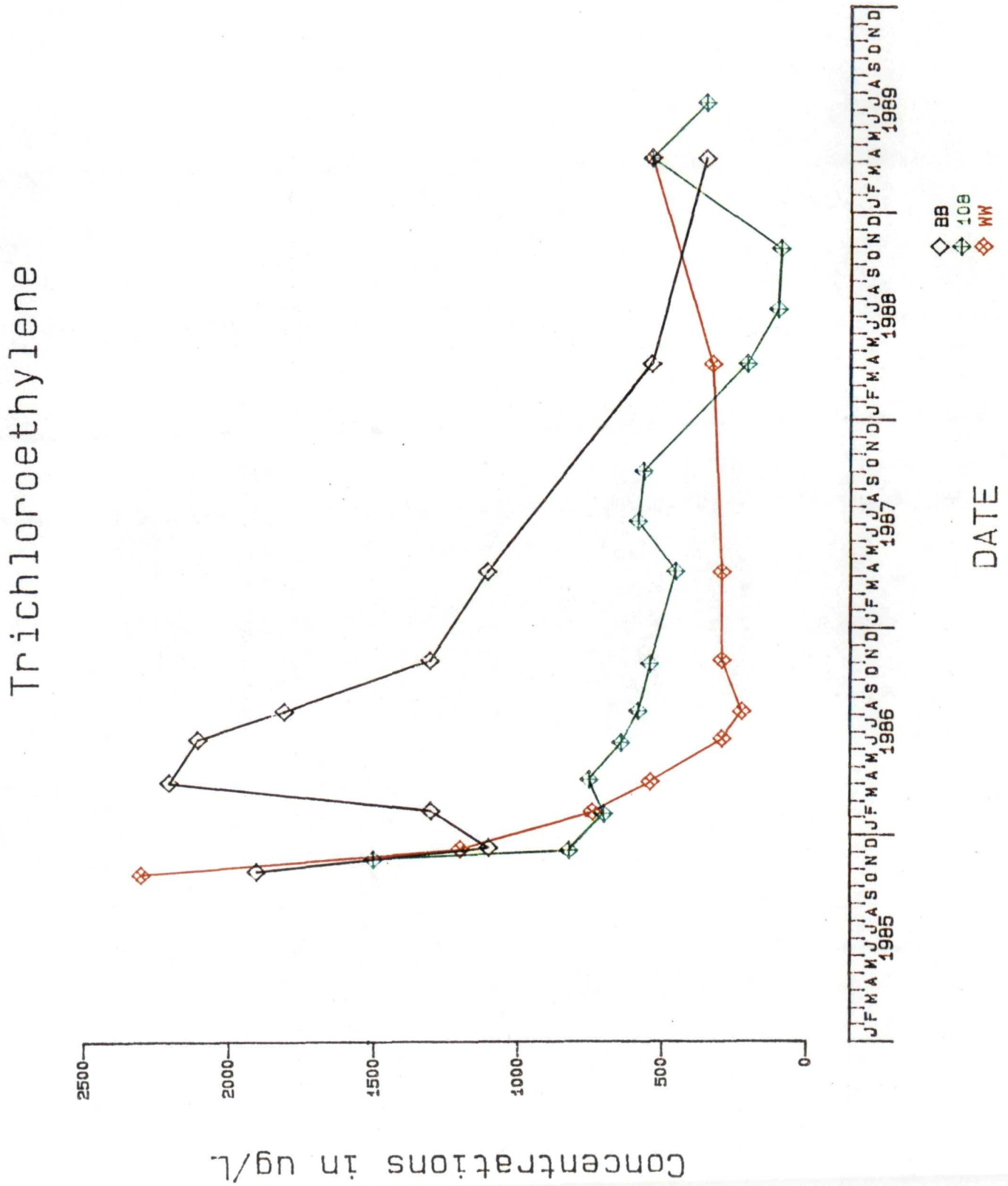


Figure 29

CARIMONA MEMBER WELLS
(TCE. VS. TIME)

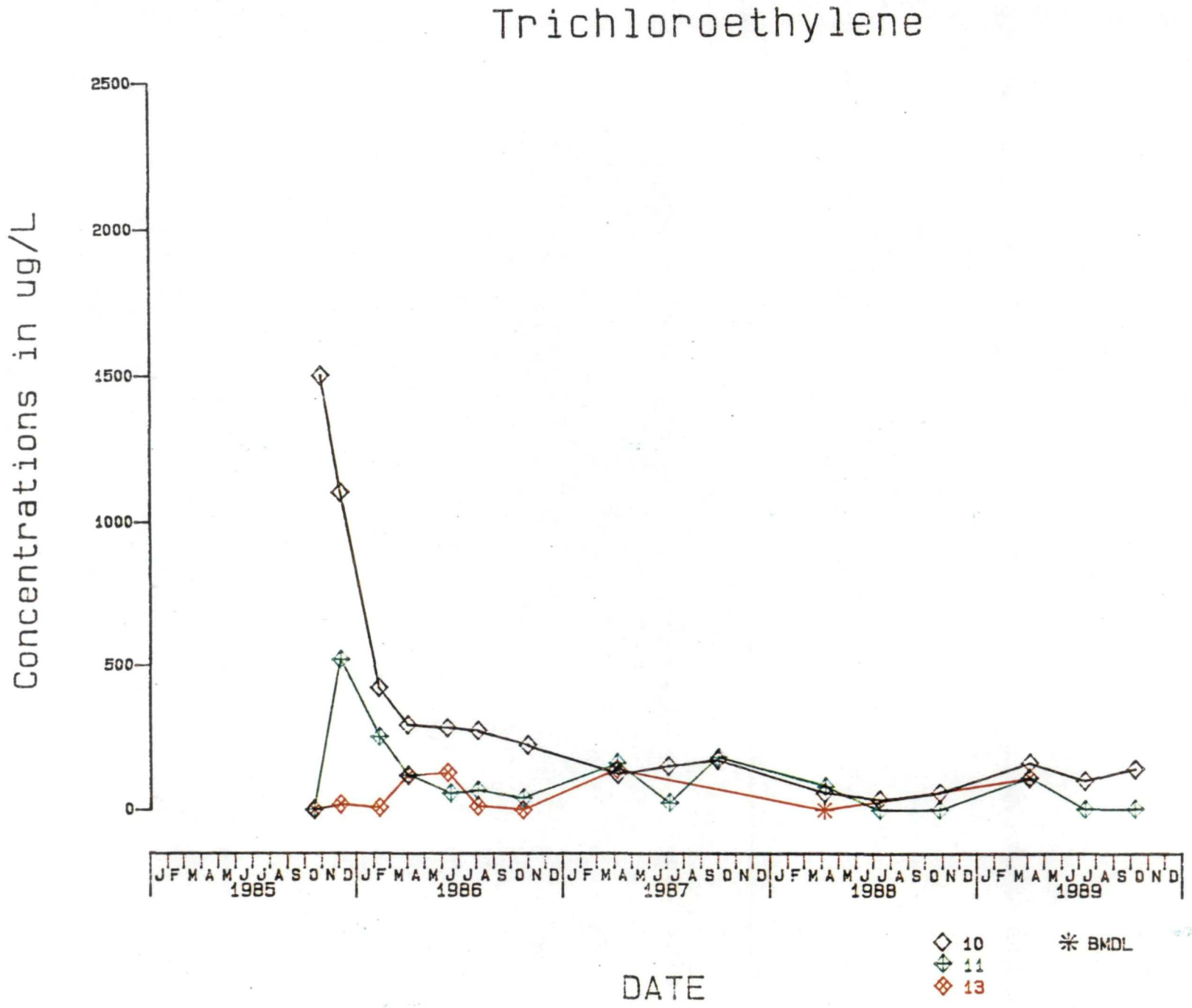


Figure 29 (cont.)
CARIMONA MEMBER WELLS
(TCE. VS. TIME)

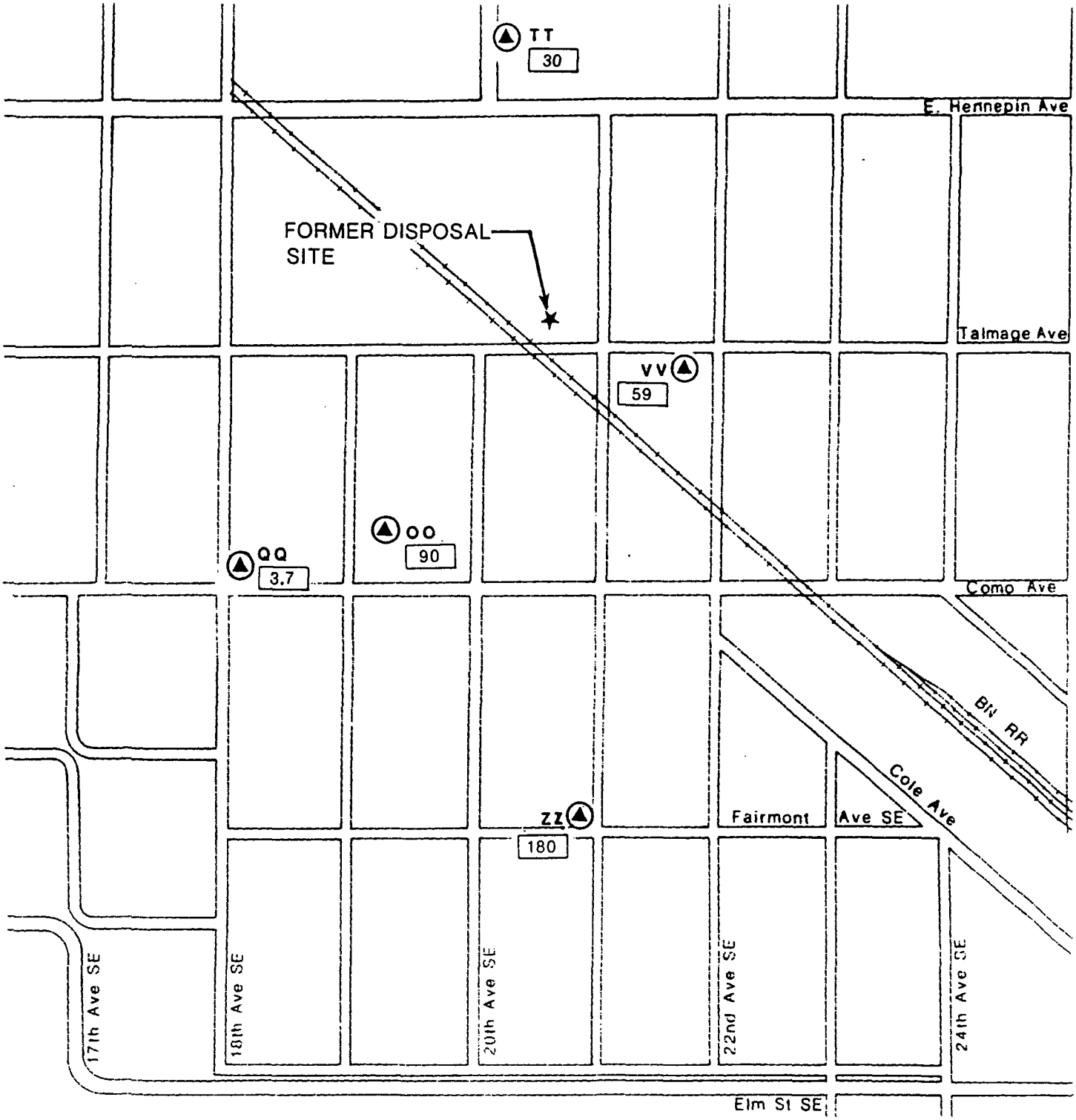


Figure 30

MAGNOLIA MEMBER
WATER QUALITY (TCE)
April 1989

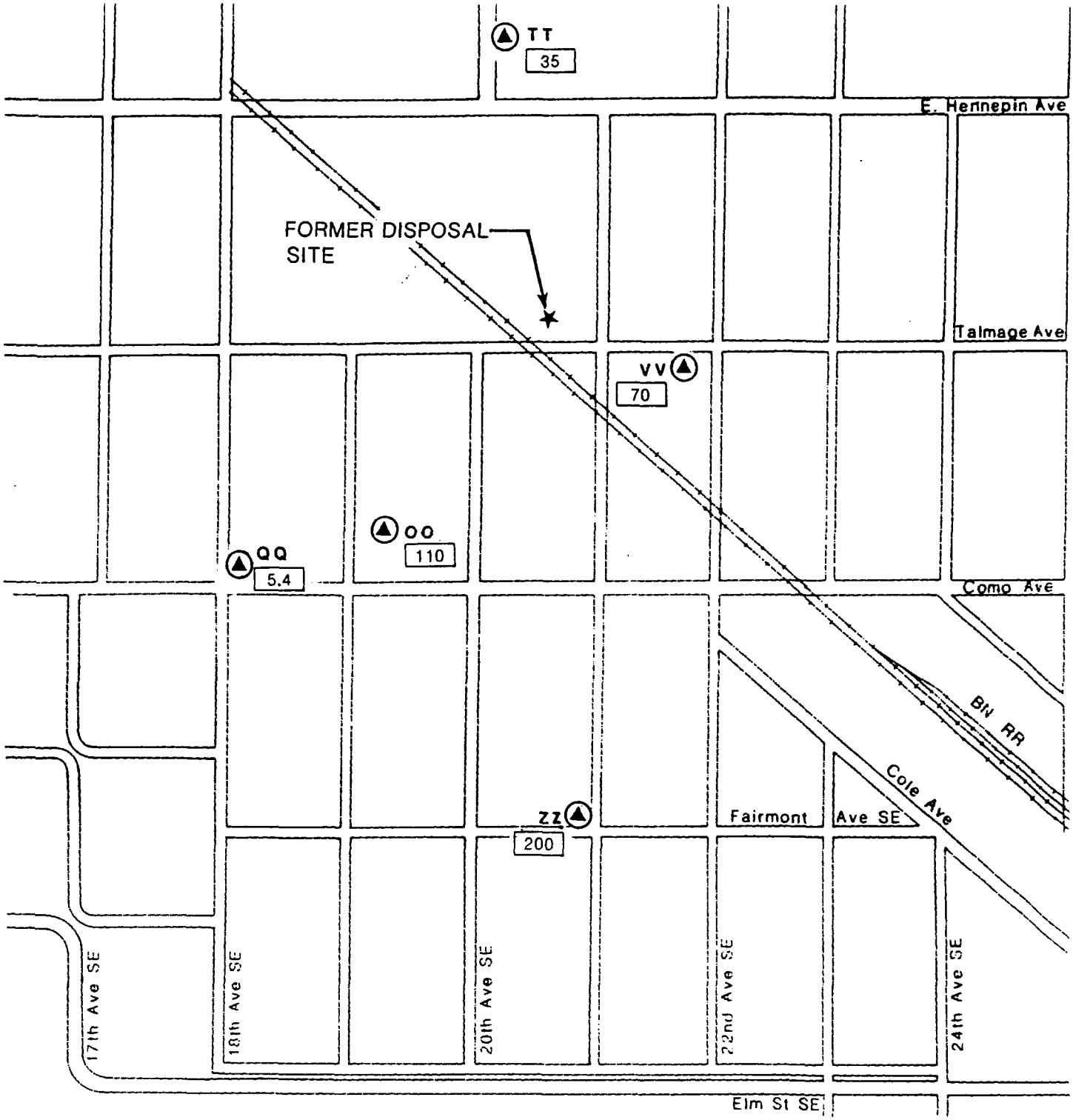


Figure 31

MAGNOLIA MEMBER
WATER QUALITY (VOC)
April 1989

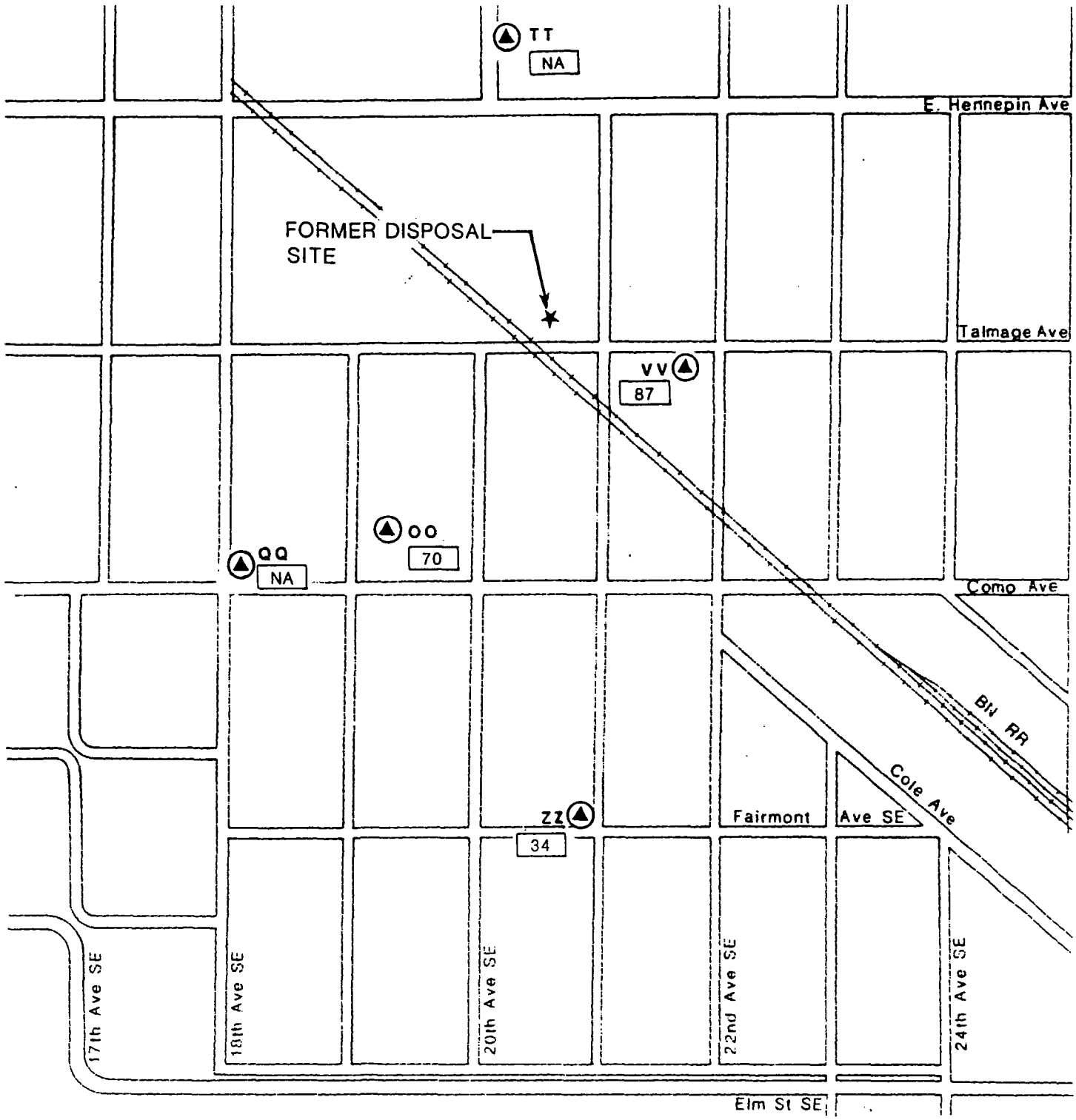


Figure 32

MAGNOLIA MEMBER
WATER QUALITY (TCE)
July 1989

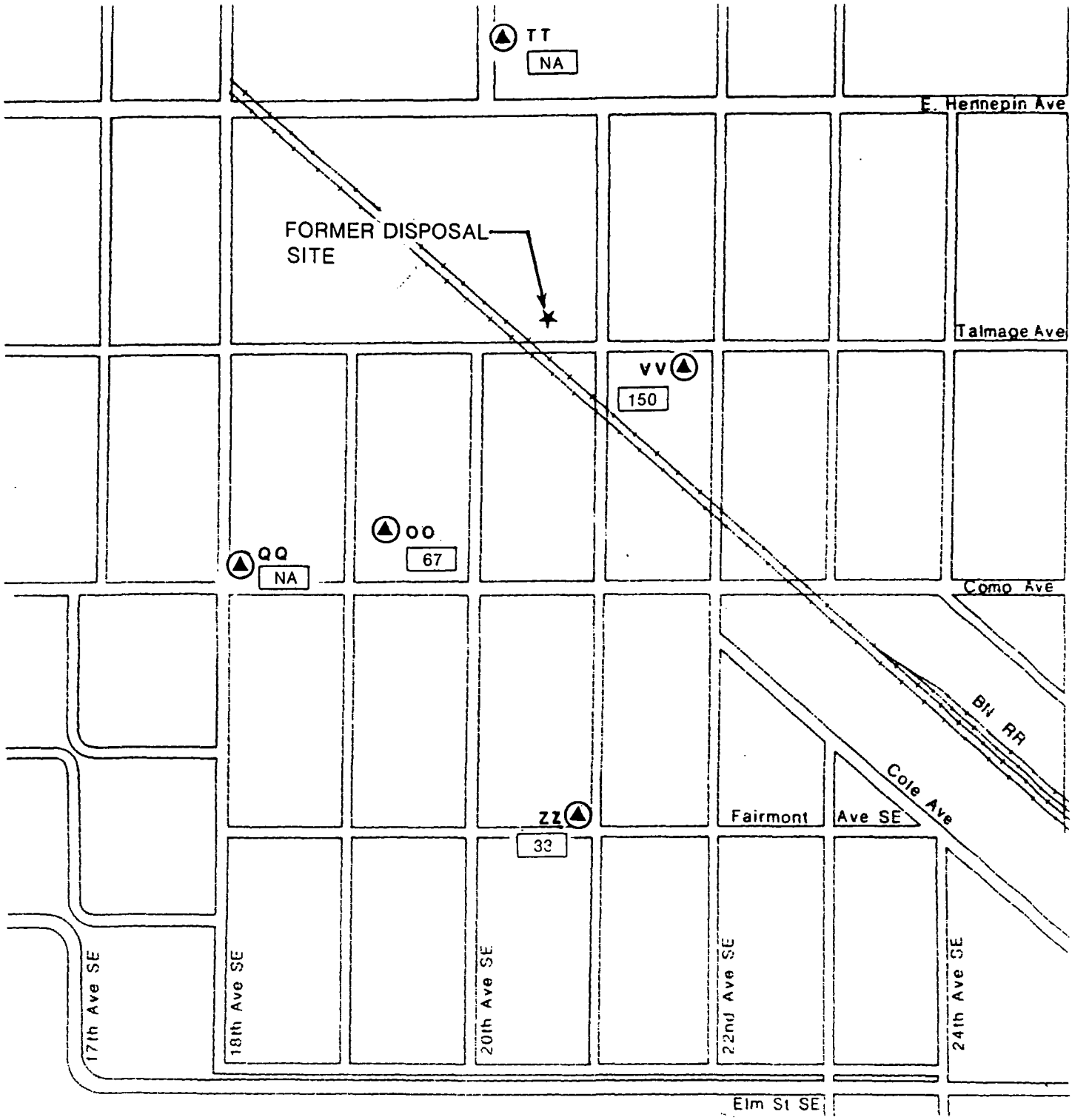


Figure 33

MAGNOLIA
WATER QUALITY
October 1989

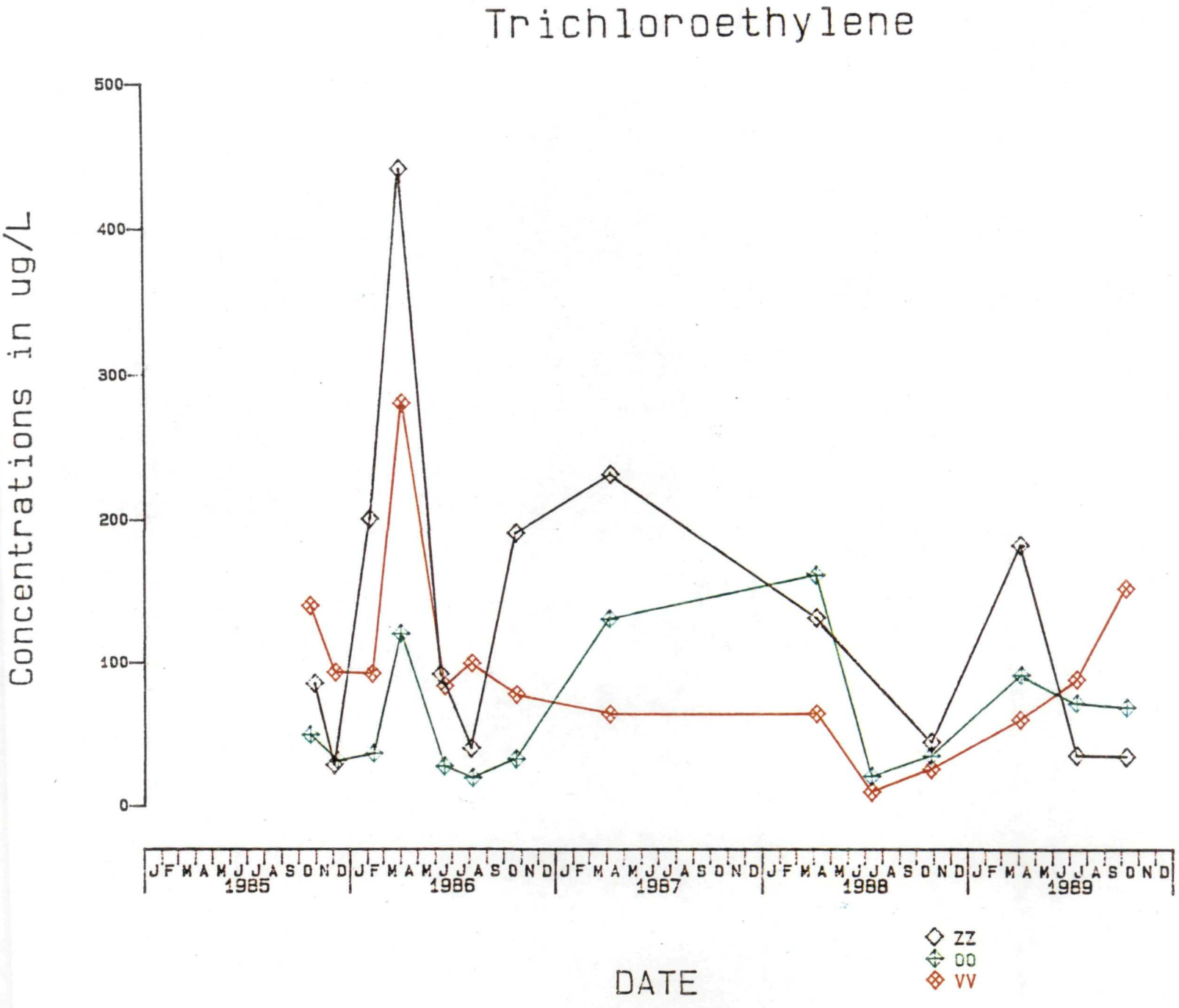
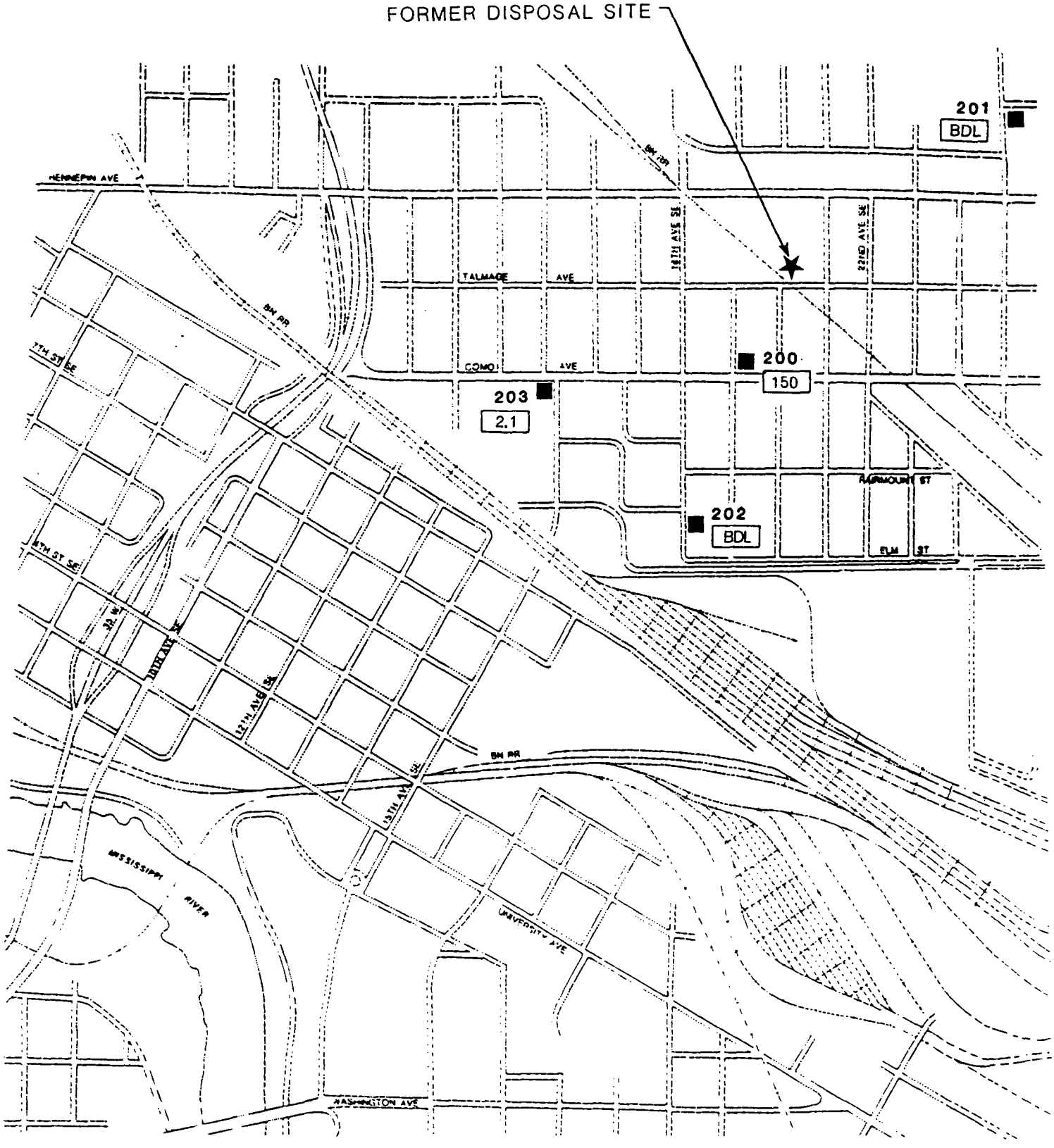


Figure 34
MAGNOLIA MEMBER WELLS
(TCE. VS. TIME)



■ ST. PETER WELL

150 TRICHLOROETHENE CONCENTRATION (ug/L) (TCE)

BDL BELOW DETECTION LIMIT

Figure 35

ST. PETER
WATER QUALITY (TCE)
April 1989

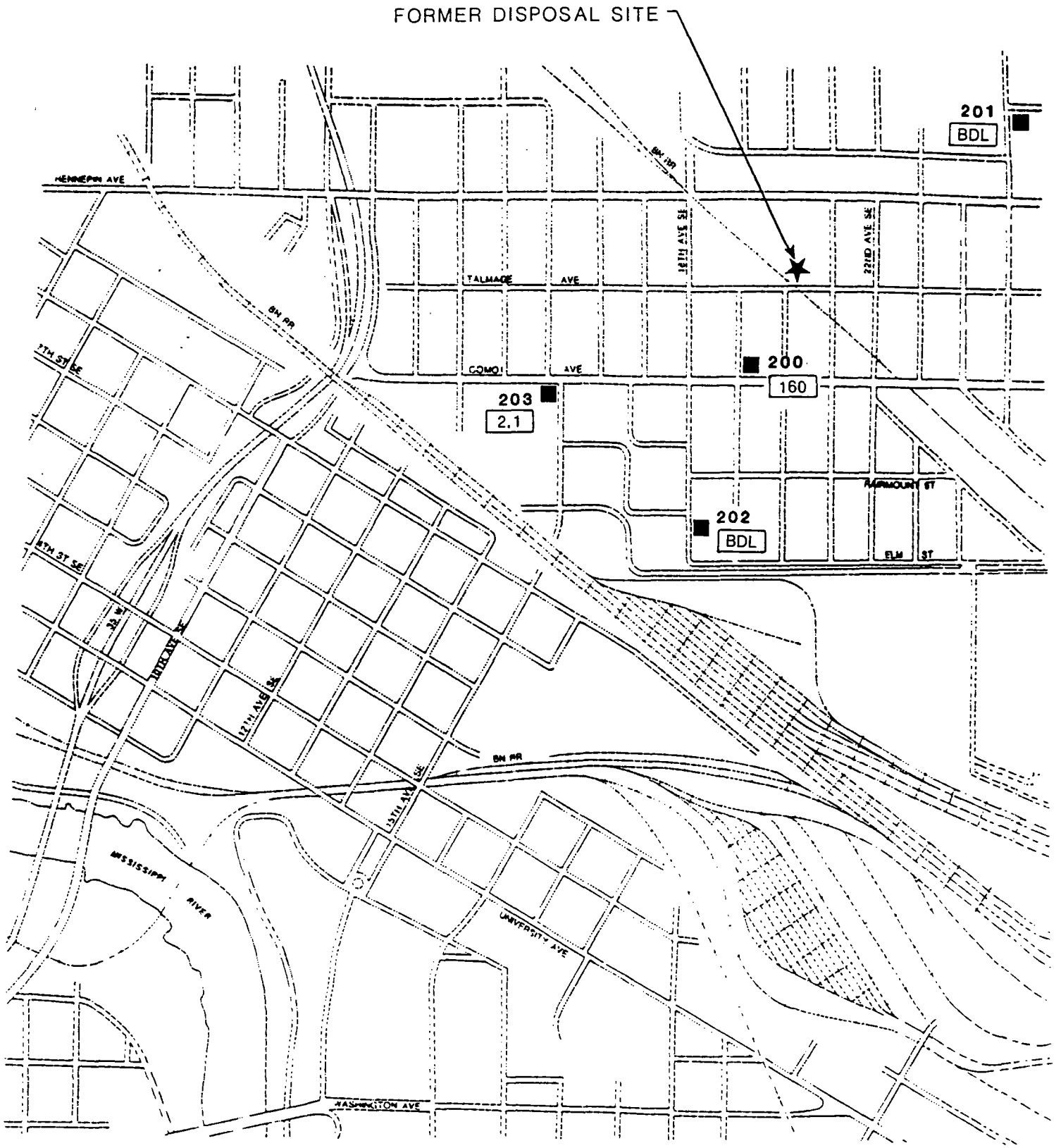


Figure 36

ST. PETER
WATER QUALITY (VOC)
April 1989

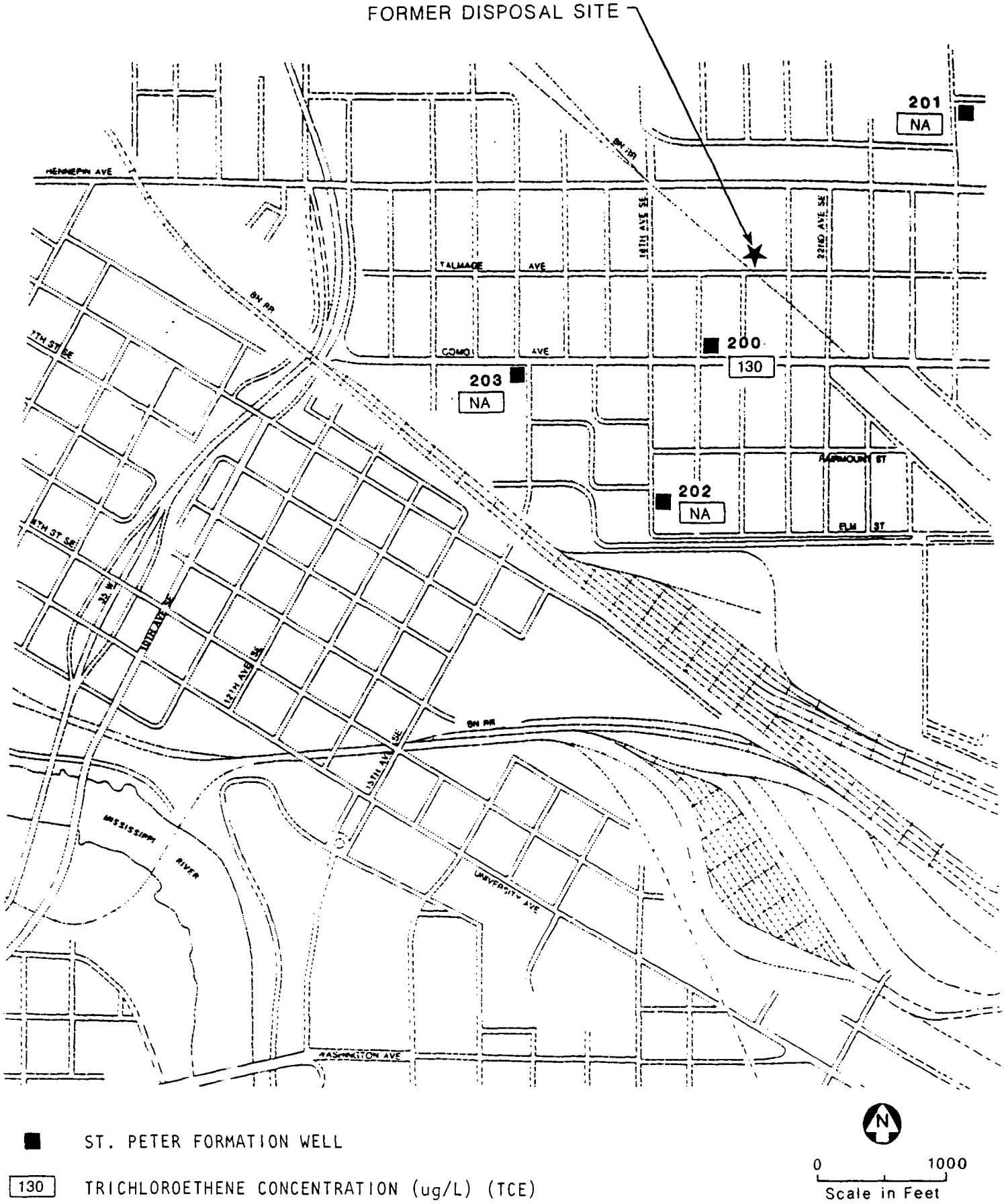


Figure 37

ST. PETER
WATER QUALITY (TCE)
July 1989

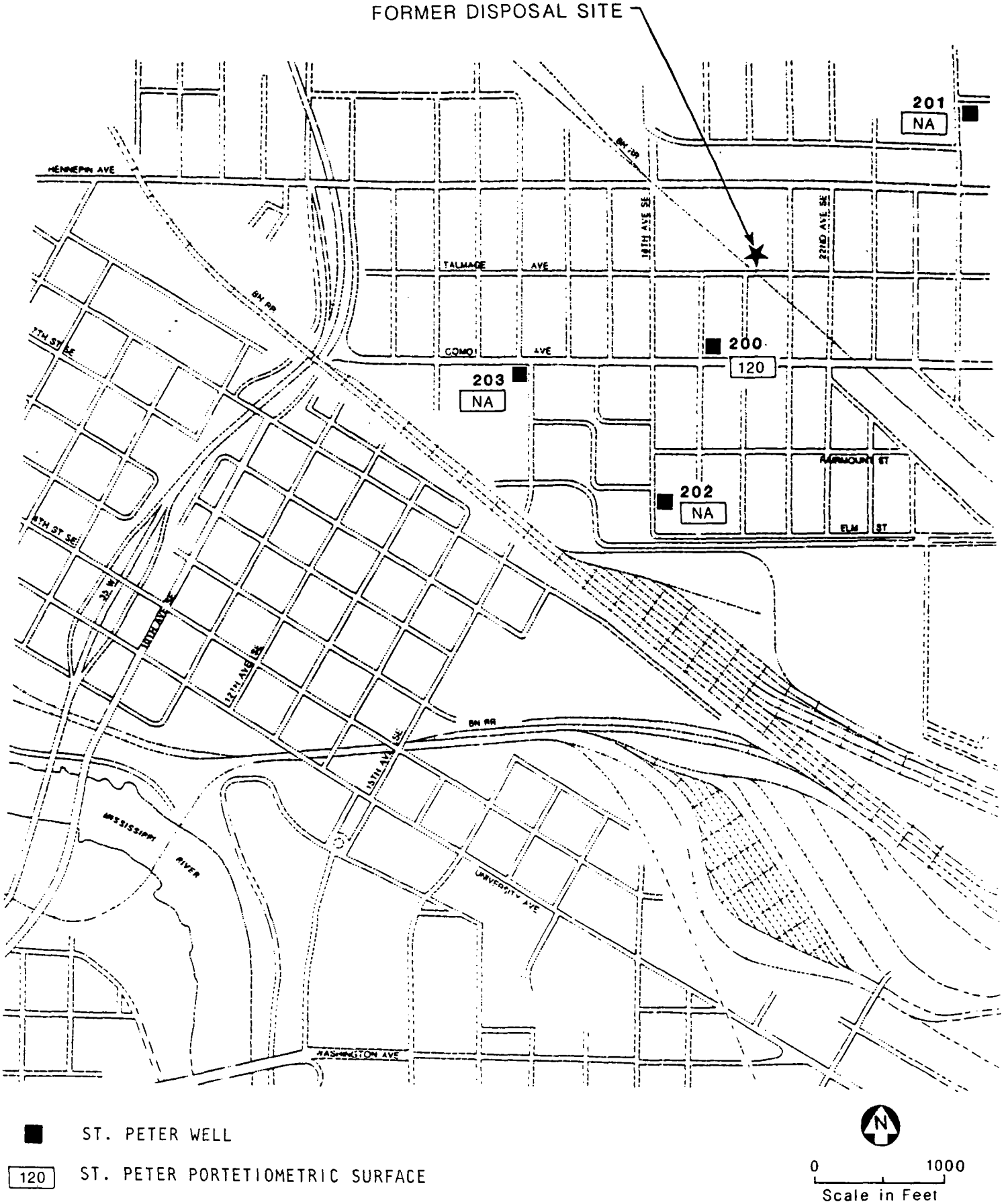


Figure 38

ST. PETER
WATER QUALITY (TCE)
October 1989

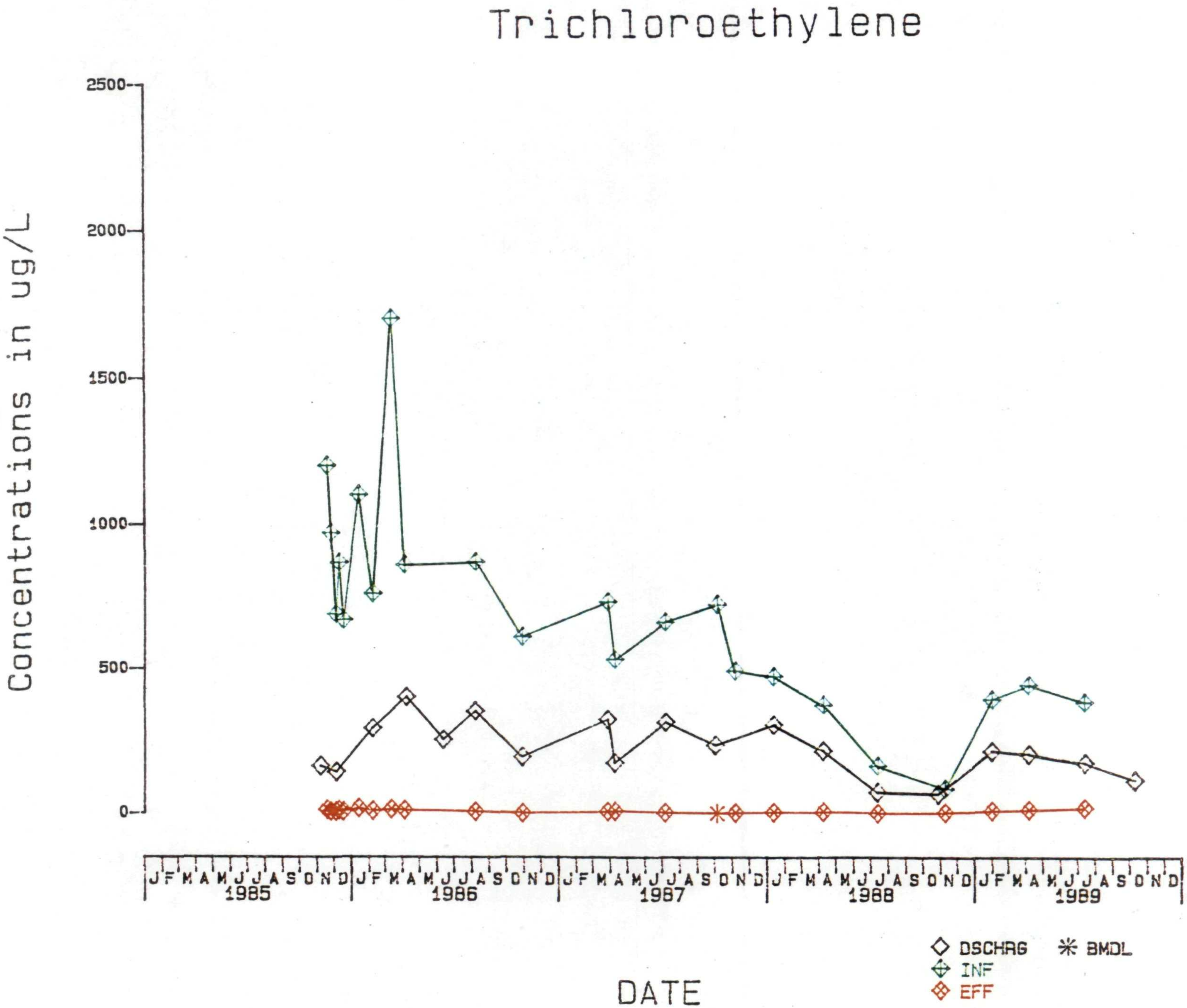


Figure 39
PUMP-OUT SYSTEM DISCHARGE AND GROUNDWATER TREATMENT SYSTEM INFLUENT/EFFLUENT (TCE. VS. TIME)

Appendix A

QA/QC DATA

APPENDIX A

QUALITY ASSURANCE/QUALITY CONTROL

LIST OF TABLES

APPENDIX A

QUALITY CONTROL REVIEW

A review of quality control data was conducted to assess the integrity of the sampling procedures and analytical results for samples collected from January through December 1989. The quality control data included analytical results from samples collected to determine both internal and external quality control. Internal quality control included initial and ongoing programs of quality assurance performed by PACE Laboratories, in accordance with their laboratory QAPP. External quality control involved the collection and analysis of field blank samples and blind duplicate samples according to procedures described in the Groundwater Monitoring Quality Control/Quality Assurance Plan submitted to the MPCA in February, 1985.

The samples were collected by Barr Engineering Co. and analyzed for volatile organic compounds by PACE Laboratories using gas chromatography according to Minnesota Department of Health Method 465B.

Internal Quality Control

PACE Laboratories conducted quality control procedures on a daily basis to determine the acceptability of the analytical results. Internal quality control procedures followed in the analysis of samples for volatile organic compounds included spiking 10 percent of the samples with reference standards and calculating the percent recovery; analyzing 10 percent of the samples in duplicate; and, analyzing laboratory blanks to check for system contamination.

Accuracy of the analytical data was assessed by evaluating recovery in spiked samples. PACE Laboratories uses Shewhart Charting Procedures to establish and track data accuracy. The upper and lower control limits for

percent recovery used by PACE are three standard deviations above or below the mean.

Data precision was assessed by evaluating laboratory duplicate analyses. PACE Laboratories uses three standard deviations above or below the mean as control limits. Quality control data generated during the analysis of samples demonstrated acceptable precision.

Laboratory deionized water blanks were analyzed periodically throughout the analysis of samples. The results of analysis of laboratory blanks were used to detect system contamination which may have contributed to possible false positive values. The mean, standard deviation, and upper limit of the 95 percent confidence interval were calculated for each set of laboratory blanks. A one-tailed student's t-test was used to compute the 95 percent confidence interval. Possible false positive values were defined as concentrations less than the upper limit of the 95 percent confidence interval. These values are footnoted with an "s" in the data tables.

External Quality Control

External quality control procedures were also used to assess laboratory precision and accuracy and the effect of sample bottle preparation and handling processes on the quality of the analytical results. Procedures included the analysis of: field blanks for detection of contamination introduced during sample collection; and, blind duplicate samples as a check on the reproducibility of the analytical data.

Nine field blank samples were collected and analyzed for volatile organic compounds. The results of the analysis for volatile organic compounds in the field blank samples are in Table A-1. Trichloroethene was detected in the field blank during the July sampling period. The mean, standard deviation and upper limit of the 95 percent confidence interval were

calculated for the field blanks collected during each sampling period (Table A-2). Possible false positive values were defined as concentration less than the upper limit of the 95 percent confidence interval. These values are footnoted with an "s" in the data tables.

Eight samples were collected in duplicate and the results of the analysis are shown in Table A-3. A coefficient of variation was computed from the results of analysis reported for each duplicate pair (Table A-4). The coefficient of variation for each duplicate pair collected during April, May and July sampling was found to be less than 25 percent, indicating acceptable reproducibility of analytical results by PACE Laboratories.

TABLE A-1

1989 FIELD BLANK DATA

(concentrations in ug/L)

	FIELD BLANKS			
	04/04/89	04/05/89	04/05/89	04/06/89
1,1-Dichloroethane	<0.2	<0.2	<0.2	<0.2
1,2-Dichloroethane	<0.2	<0.2	<0.2	<0.2
1,2-Dichloroethylene, cis	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethylene, trans	<0.3	<0.3	<0.3	<0.3
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	<1.0
Tetrachloroethylene	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5
Benzene	--	--	--	--
Toluene	--	--	--	--
Xylenes	--	--	--	--

	FIELD BLANKS			
	07/13/89	07/14/89	10/09/89	10/10/89
1,1-Dichloroethane	<0.2	--	<0.2	<0.2
1,2-Dichloroethane	<0.2	--	<0.2	<0.2
1,2-Dichloroethylene, cis	<0.5	--	<0.5	<0.5
1,2-Dichloroethylene, trans	<0.3	--	<0.3	<0.3
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	<1.0
Tetrachloroethylene	<1.0	--	<1.0	<1.0
1,1,1-Trichloroethane	<0.5	--	<0.5	<0.5
Trichloroethene	0.7	<0.5	<0.5	<0.5
Benzene	--	--	<1.0	--
Toluene	--	--	<1.0	--
Xylenes	--	--	<1.0	--

-- Not analyzed.

.010

TABLE A-2

FIELD BLANK DATA
RESULTS OF STATISTICAL ANALYSIS

(Concentrations in µg/l)

	April 1989			July 1989			October 1989		
	$\bar{x}$	s	UCL	$\bar{x}$	s	UCL	$\bar{x}$	s	UCL
Parameter									
1,1-Dichloroethane	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
1,2-Dichloroethane	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
1,1,2,2-Tetrachloroethane	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
1,1,1-Trichloroethane	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
1,2-Dichloroethene, cis	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
1,2-Dichloroethene, trans	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
Tetrachloroethene	BDL	0	BDL	BDL	0	BDL	BDL	0	BDL
Trichloroethene	BDL	0	BDL	0.5	0.3	2.5	BDL	0	BDL
Benzene	--	--	--	--	--	--	BDL	0	BDL
Toluene	--	--	--	--	--	--	BDL	0	BDL
Xylenes	--	--	--	--	--	--	BDL	0	BDL

UCL: Upper Limit of 95 percent confidence interval calculated using a one-tailed student's t-test.

BDL: Below laboratory detection limit.

-- : Not analyzed.

2327169/GMRPT.WP/KML

TABLE A-3

1989 BLIND DUPLICATE DATA

(concentrations in ug/L)

	TT		200		201	
	04/04/89 Sample	04/04/89 Duplicate	04/05/89 Sample	04/05/89 Duplicate	04/05/89 Sample	04/05/89 Duplicate
1,1-Dichloroethane	1.6	<0.2	<1.0	<1.0	<0.2	<0.2
1,2-Dichloroethane	<0.2	<0.2	<1.0	<1.0	<0.2	<0.2
1,2-Dichloroethylene, cis	3.7	3.9	13	17	<0.5	<0.5
1,2-Dichloroethylene, trans	<0.3	<0.3	<1.5	<1.5	<0.3	<0.3
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<5.0	<5.0	<1.0	<1.0
Tetrachloroethylene	<1.0	<1.0	<5.0	<5.0	<1.0	<1.0
1,1,1-Trichloroethane	<1.0	<0.5	<2.5	<2.5	<0.5	<0.5
Trichloroethene	30	27	150	180	<0.5	<0.5
Sum of Volatile Organics	35	31	160	200	ND	ND

	V		11		ZZ	
	04/05/89 Sample	04/05/89 Duplicate	07/13/89 Sample	07/13/89 Duplicate	07/14/89 Sample	07/14/89 Duplicate
1,1-Dichloroethane	<0.2	<1.0	--	--	--	--
1,2-Dichloroethane	<0.2	<1.0	--	--	--	--
1,2-Dichloroethylene, cis	8.7	13	--	--	--	--
1,2-Dichloroethylene, trans	0.4	<1.5	--	--	--	--
1,1,2,2-Tetrachloroethane	<1.0	<5.0	--	--	--	--
Tetrachloroethylene	<1.0	<5.0	--	--	--	--
1,1,1-Trichloroethane	<0.5	<2.5	--	--	--	--
Trichloroethene	130	140	3.6	3.2	34	27
Sum of Volatile Organics	140	150	3.6	3.2	34	27

	V		200	
	10/09/89 Sample	10/09/89 Duplicate	10/10/89 Sample	10/10/89 Duplicate
1,1-Dichloroethane	--	--	--	--
1,2-Dichloroethane	--	--	--	--
1,2-Dichloroethylene, cis	--	--	--	--
1,2-Dichloroethylene, trans	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--
Tetrachloroethylene	--	--	--	--
1,1,1-Trichloroethane	--	--	--	--
Trichloroethene	120	120	120	120
Sum of Volatile Organics	120	120	120	120

-- Not analyzed.

TABLE A-4

BLIND DUPLICATE DATA
COEFFICIENTS OF VARIATION

Well	Date	Coefficient of Variation
TT	04/04/89	0.03
V	04/05/89	0.10
200	04/05/89	0.08
201	04/05/89	0.00
11	07/13/89	0.08
ZZ	07/14/89	0.16
V	10/10/89	0.00
200	10/10/89	0.00

Appendix B

RECOMMENDED 1990 MONITORING PLAN

APPENDIX B

RECOMMENDED 1990 MONITORING PLAN

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APPENDIX B

RECOMMENDED 1990 MONITORING PLAN

INTRODUCTION

The following monitoring plan is recommended for the period January, 1990 through December 1990 to fulfill the requirements of Section 1.9 of Part II of Exhibit A to the Order by Consent between General Mills, Inc. and the MPCA dated October 12, 1984. The monitoring plan is similar to the 1989 Monitoring Plan and will provide uniformity between the two years. The 1990 monitoring locations are shown on Figures B-1 through B-4. Water quality samples collected during the second quarter will be analyzed for volatile compounds presented in Table B-2. Water quality samples collected during the third and fourth quarters will be analyzed for trichloroethene. Additional monitoring of site pump-out well effluent (108, 109 and 110), downgradient pump-out well effluent (111, 112 and 113), and stripper tower effluent will be conducted according to NPDES Permit MN0056022. A summary of the sampling schedule including monitoring activities and parameters for analysis are presented by monitoring location and sampling period in Table B-1.

GLACIAL DRIFT

The following monitoring program will be followed to monitor the continued effectiveness of the glacial drift pump-out systems:

- Water levels will be measured in Wells 1, 3, Q, R, S, T, V, W, X, 109, 110, 111, 112 and 113 during the second, third and fourth quarters.

- Water levels will be measured in Wells 4, 106, 107, B and U during the second quarter.

- Samples will be collected from Wells 1, 3, R, S, V and W during the third and fourth quarters and analyzed for trichloroethene.

- Samples will be collected from Wells 1, 3, 4, B, Q, R, S, T, V, W and X during the second quarter and analyzed for the List 1 compounds in Table B-2.

CARIMONA MEMBER

The following monitoring program will be observed to confirm the Carimona pump-out system continues to influence the Carimona in the vicinity of the East Hennepin Avenue site:

- Water levels will be measured in Wells 8, 9, 10, 11, 12, 13, 108, RR and SS during the second, third and fourth quarters.

- Water levels will be measured in Wells BB, UU and WW during the second quarter.

- Water samples will be collected from Wells 9, 10, 11, 12 and 108 during the third and fourth quarters and analyzed for trichloroethene.

- Water samples will be collected from Wells 8, 9, 10, 11, 12, 13, 108, BB, RR, SS, UU and WW during the second quarter and analyzed for the List 1 compounds in Table B-2.

MAGNOLIA MEMBER

- Water levels will be measured in Wells OO, QQ, TT, VV and ZZ during the second, third and fourth quarters.

- All Magnolia wells will be sampled during the second quarter and analyzed for the List 1 compounds in Table B-2.

- Wells OO, VV and ZZ will be sampled during the third and fourth quarters and analyzed for trichloroethene.

ST. PETER

- Water levels will be measured in Wells 200, 201, 202 and 203 during the second, third and fourth quarters.

- All St. Peter wells will be sampled in the second quarter and analyzed for the List 1 compounds in Table B-2.

- Well 200 will be sampled in the third and fourth quarters and analyzed for trichloroethene.

PRAIRIE DU CHIEN/JORDAN (Henkel Well)

- Due to its inaccessibility, the Henkel Well is not included in the 1990 Monitoring Plan.

REPORTING

Quarterly

General Mills shall submit the analytical results to the MPCA Project Leader by the 15th day of the month following completion of all analyses of samples collected during the previous quarterly sampling period.

Annual Monitoring Report

General Mills shall submit an annual monitoring report for the previous calendar year to the MPCA Project Leader on or before January 15, 19quit 90. Each annual report shall contain the following information:

- Results of all water level measurements and chemical analyses for the previous calendar year.

- Water level contour maps for each aquifer showing high and low groundwater levels.

- Vertical cross sections of the glacial drift groundwater elevations between Wells 1 and W.

- Maps showing the sum of the List 1 compounds listed in Table B-2 for each well location monitored during the second quarter sampling event, and maps showing the TCE concentrations for each monitoring location of each sampling event.

- A proposed sampling plan for the next monitoring year including an assessment of the monitoring parameters and frequencies, and the feasibility for the deletion of monitoring wells, parameters, or a decrease in sampling frequency.

- A discussion and summary of the reporting year's data in comparison to previously available data.

TABLE B-1

RECOMMENDED 1990 WATER LEVEL
MONITORING LOCATIONS

	Monitoring Station	Apr-May Monitoring	Jul-Aug Monitoring	Oct-Nov Monitoring
Glacial Drift	1	WL[1]	WL	WL
	3	WL	WL	WL
	4	WL	--	--
	106	WL	--	--
	107	WL	--	--
	109[2]	WL	WL	WL
	110[2]	WL	WL	WL
	111[2]	WL	WL	WL
	112[2]	WL	WL	WL
	113[2]	WL	WL	WL
	B	WL	--	--
	Q	WL	WL	WL
	R	WL	WL	WL
	S	WL	WL	WL
	T	WL	WL	WL
	U	WL	--	--
	V	WL	WL	WL
	W	WL	WL	WL
	X	WL	WL	WL
Carimona	8	WL	WL	WL
	9	WL	WL	WL
	10	WL	WL	WL
	11	WL	WL	WL
	12	WL	WL	WL
	13	WL	WL	WL
	108[2]	WL	WL	WL
	BB	WL	--	--
	RR	WL	WL	WL
	SS	WL	WL	WL
	UU	WL	--	--
	WW	WL	--	--
Magnolia	OO	WL	WL	WL
	QQ	WL	WL	WL
	TT	WL	WL	WL
	VV	WL	WL	WL
	ZZ	WL	WL	WL
St. Peter	200	WL	WL	WL
	201	WL	WL	WL
	202	WL	WL	WL
	203	WL	WL	WL

[1] Water level measurement.

[2] Pump-out well.

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TABLE B-1

(Continued)

RECOMMENDED
1990 MONITORING STATIONS AND SAMPLING FREQUENCIES

	Monitoring Station	Apr-May Parameter List	Jul-Aug Parameter List	Oct-Nov Parameter List
Glacial Drift	1	List 1[3]	TCE[4]	TCE
	3	List 1	TCE	TCE
	4	List 1	--	--
	106	--	--	--
	107	--	--	--
	B	List 1	--	--
	Q	List 1	--	--
	R	List 1	TCE	TCE
	S	List 1	TCE	TCE
	T	List 1	--	--
	U	--	--	--
	V	List 1	TCE	TCE
	W	List 1	TCE	TCE
	X	List 1	--	--
Carimona	8	List 1	--	--
	9	List 1	TCE	TCE
	10	List 1	TCE	TCE
	11	List 1	TCE	TCE
	12	List 1	TCE	TCE
	13	List 1	--	--
	108	List 1	TCE	TCE
	BB	List 1	--	--
	RR	List 1	--	--
	SS	List 1	--	--
	UU	List 1	--	--
	WW	List 1	--	--
Magnolia	OO	List 1	TCE	TCE
	QQ	List 1	--	--
	TT	List 1	--	--
	VV	List 1	TCE	TCE
	ZZ	List 1	TCE	TCE
St. Peter	200	List 1	TCE	TCE
	201	List 1	--	--
	202	List 1	--	--
	203	List 1	--	--

[3] List 1 - Collection and analysis of water quality samples for List 1 parameters.

[4] TCE - Collection and analysis of water quality samples for trichlorethene.

2327169/GMRPT.WP/KML

TABLE B-1

(Continued)

RECOMMENDED
1990 MONITORING STATIONS AND SAMPLING FREQUENCIES

	Jan-Feb	Apr-May	Jul-Aug	Oct-Nov
Influent (Pump-Out Wells 108, 109, 110), 20100	TCE[4]	List 2[5]	TCE	List 1a[6]
Effluent (Pump-Out Wells 108, 109, 110), 20100	TCE	List 1a	TCE	List 1a
Discharge (Pump-Out Wells 111, 112, 113), 20200	TCE	List 1a	TCE	List 1a

---

[5] List 2 - Collection and analysis of water quality samples for List 2 parameters.

[6] List 1a - Collection and analysis of water quality samples for List 1a parameters.

TABLE B-2

RECOMMENDED
1990 WATER QUALITY ANALYTICAL PARAMETER LISTS

LIST 1

Chlorinated Volatile Solvents

1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloroethylene, cis
1,2-Dichloroethylene, trans
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
1,1,1-Trichloroethane
Trichloroethene

LIST 1A

Chlorinated Volatile Solvents

1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloroethylene, cis
1,2-Dichloroethylene, trans
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
1,1,1-Trichloroethane
Trichloroethene

Non-Chlorinated Volatile Solvents

Benzene
Toluene
Xylenes

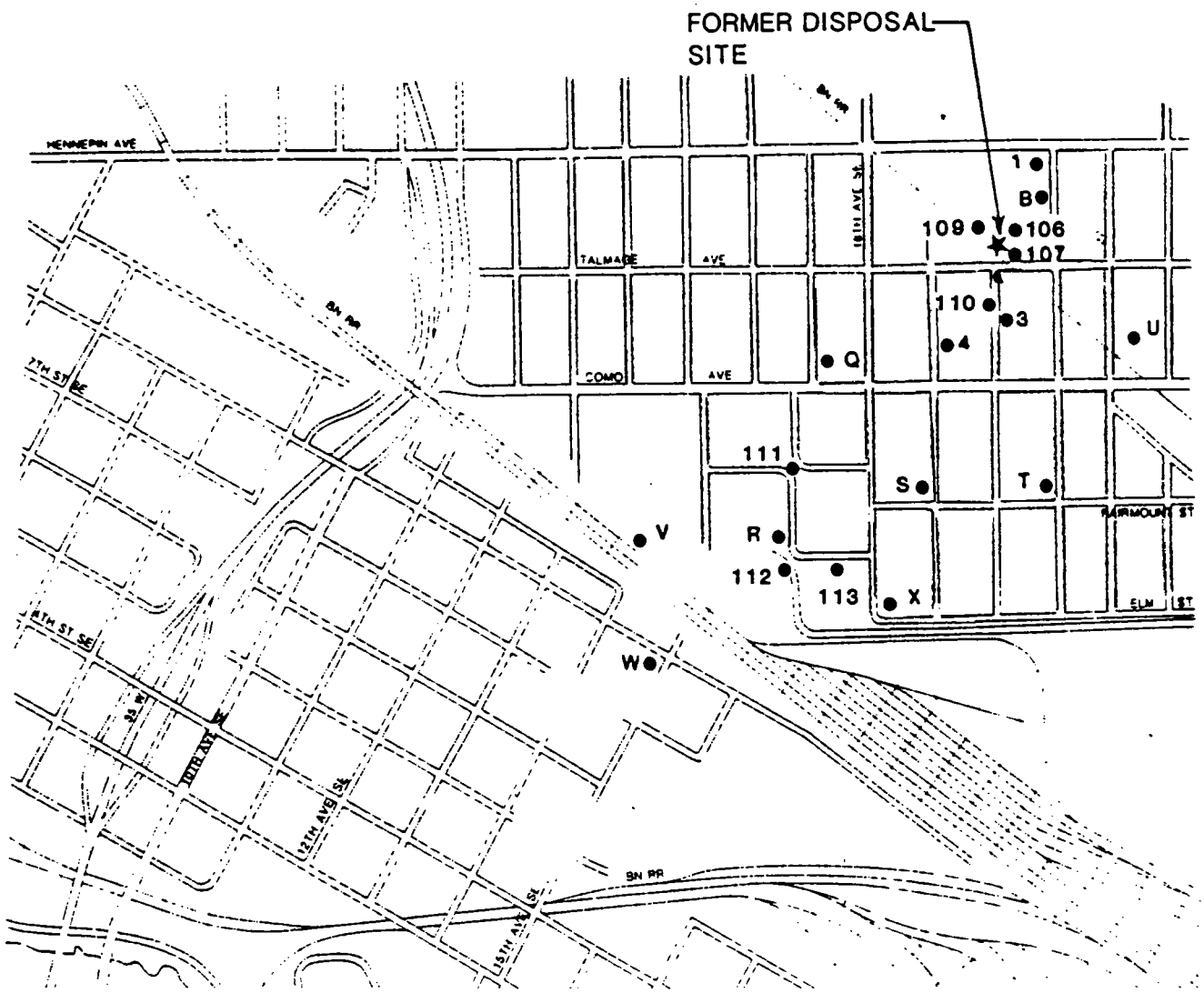
LIST 2[1]

Priority Pollutants
Volatile Organics

Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethylvinyl Ether
Chloroform
Chloromethane
Chlorodibromomethane
1,1-Dichloroethane
1,1,2-Trichloroethane
Vinyl Chloride
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene (cis/trans)
1,2-Dichloropropane
cis-1,3-Dichloropropane
trans-1,3-Dichloropropene
Ethyl Benzene
Methylene Chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
Trichloroethene

[1] List 2 - Analyzed using EPA Method 624 with tentatively identified compounds (TIC).

2327169/GMRPT.WP/KML



● GLACIAL DRIFT MONITORING WELL

N

0 1000

Scale in Feet

Figure B-1

GLACIAL DRIFT AQUIFER
1990 MONITORING LOCATIONS

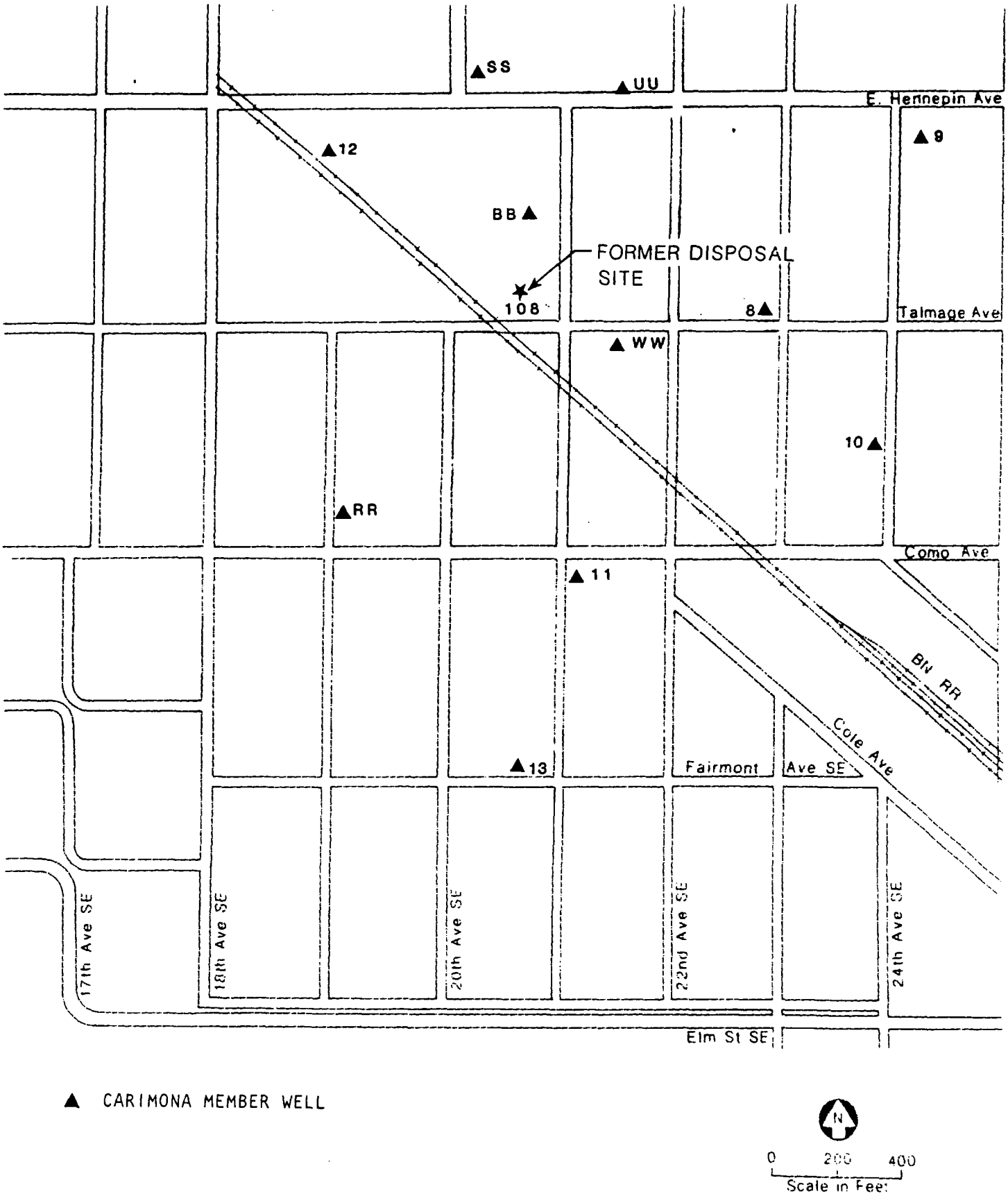


Figure B-2

CARIMONA MEMBER
1990 MONITORING LOCATIONS

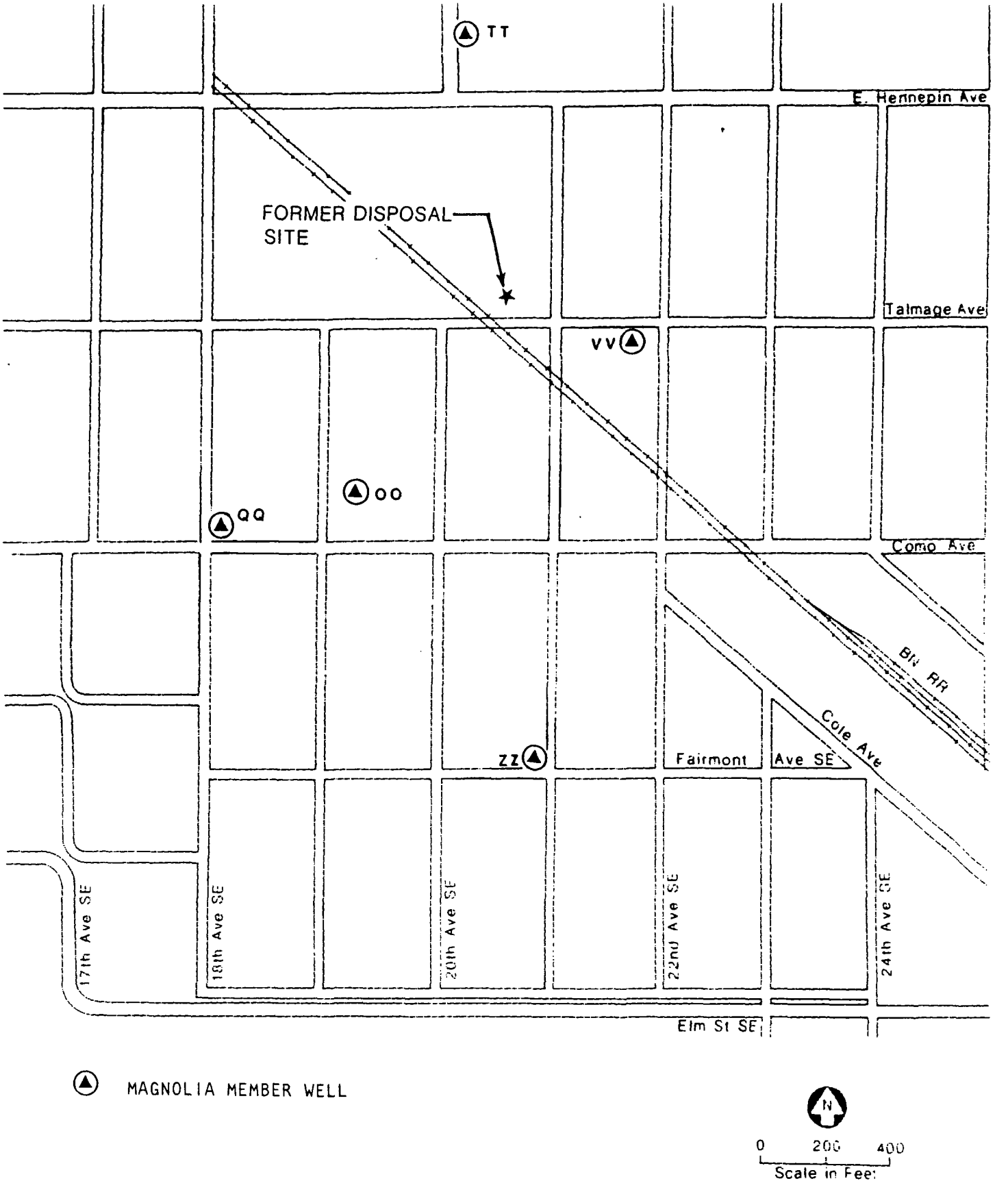


Figure B-3

MAGNOLIA MEMBER
1990 MONITORING LOCATIONS

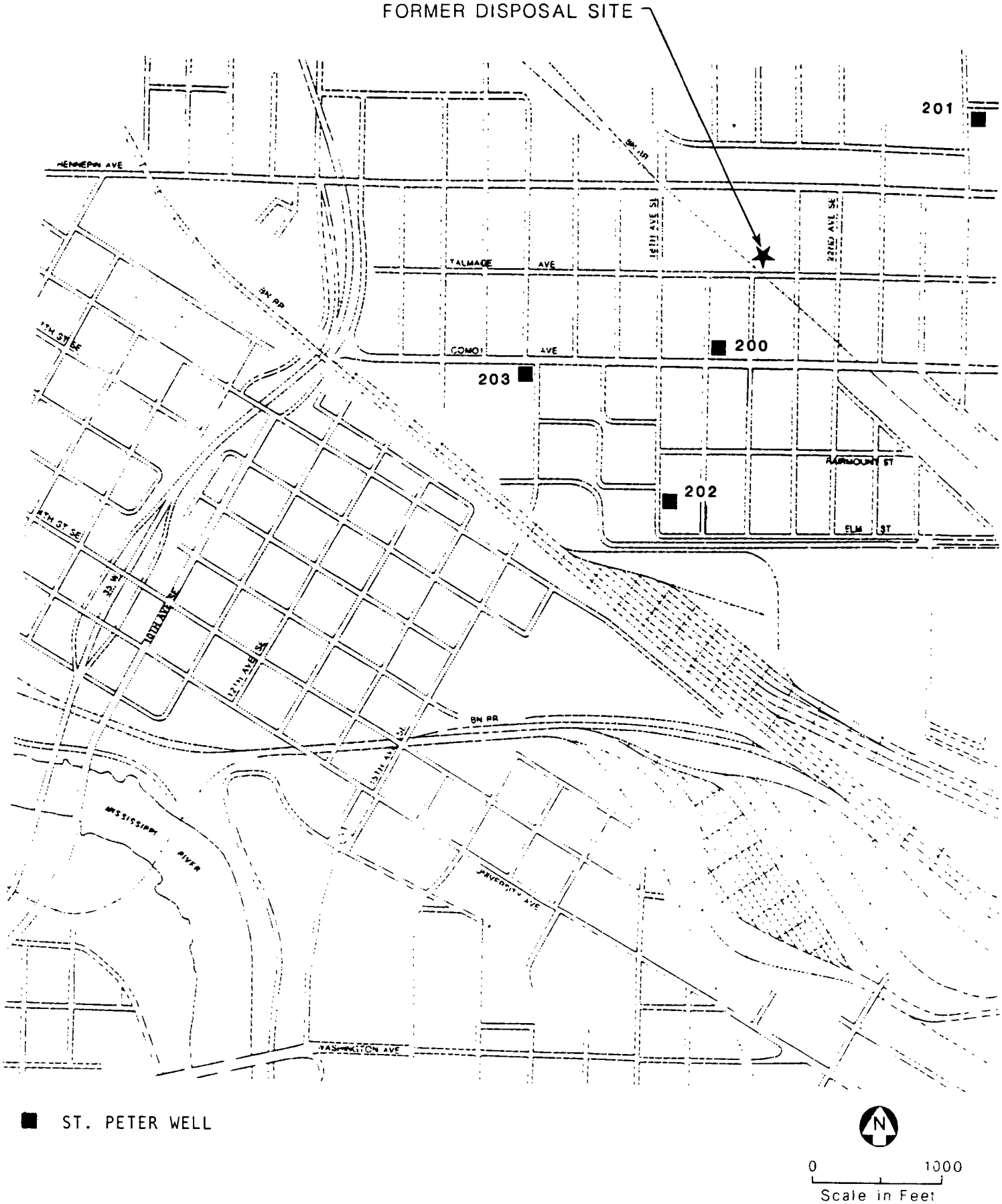


Figure B-4

ST. PETER
1990 MONITORING LOCATIONS

Appendix C

HISTORICAL WATER DATA QUALITY

APPENDIX C

HISTORICAL WATER QUALITY DATA

LIST OF TABLES

TABLE C-1

HISTORICAL WATER QUALITY DATA
GLACIAL DRIFT WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	B	Q	R	S	T
04/82	6.0	--	--	--	--
12/82	1100	--	--	--	--
12/83	780	--	--	--	--
02/84	--	<1.3	670	770	<1.3
10/85	1200	20	1100	740	<0.3
12/85	1100	14	820	750	<0.8
02/86	1300	11	31	650	<0.5
04/86	1000	13	DRY	1100	<0.2
06/86	1100	4.7	160	930	<0.2
08/86	1000	5.6	DRY	880	<0.2
10/86	--	3.2	--	620	<0.2
11/86	830	--	--	--	--
04/87	800	2.6	DRY	650	<0.2
07/87	--	--	DRY	740	--
10/87	--	--	--	1000	--
04/88	330	0.86	DRY	460	<0.50
07/88	--	--	DRY	160	--
10/88	--	--	DRY	110	--
04/89	250	1.1	--	860	<0.5
07/89	--	--	--	620	--
10/89	--	--	--	630	--

-- Not analyzed.

2,.006

TABLE C-1 (cont.)

HISTORICAL WATER QUALITY DATA
GLACIAL DRIFT WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	U	V	W	X
02/84	<1.3	--	--	--
03/84	--	78	7.5	2.2
10/85	2.6	220	8.1	2.1
12/85	3.9	140	32	5.0
02/86	2.9	180	14	0.9 s
04/86	3.2	170	18	0.9
06/86	1.6	97	10	0.9
08/86	16	130	18	0.7
10/86	1.4	92	6.2	0.5
04/87	2.7	160	24	--
07/87	--	180	42	--
10/87	--	140	56	--
04/88	--	160	43	DRY
07/88	--	33	8.1	--
10/88	--	37	26	--
04/89	--	130	57	--
07/89	--	120	22	--
10/89	--	120	25	--

---

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

2,.006

TABLE C-1 (cont.)

HISTORICAL WATER QUALITY DATA
GLACIAL DRIFT WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	1	3	4
04/82	6.0	780	4.5
12/83	27	800	380
10/85	1.4	1100	--
11/85	--	--	440
12/85	1.5	770	440
02/86	1.4 s	680	200
04/86	3.1	1200	210
06/86	8.1	1300	180
08/86	9.3	890	280
10/86	0.9	720	200
04/87	2.7	740	120
07/87	0.4	770	--
10/87	0.8	960	--
04/88	<0.50	440	55
07/88	0.5	140	--
10/88	<0.5	98	--
04/89	0.8	320	55
07/89		340	--
10/89	--	530	--

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

2,.006

TABLE C-2

HISTORICAL WATER QUALITY DATA
CARIMONA MEMBER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	BB	RR	SS	UU	WW
05/82	--	46	--	--	--
06/82	1600	--	--	--	--
12/82	1600	43	<0.05	78	2100
12/83	1400	33	<1.5	81	1700
10/85	1900	110	0.4 s	150	2300
12/85	1100	95	1.2	79	1200
02/86	1300	88	<0.5	71	740
04/86	2200	170	0.4	81	540
06/86	2100	85	0.3	37	290
08/86	1800	100	0.3	45	220
10/86	--	--	<0.2	36	--
11/86	1300	100	--	--	--
04/87	1100	110	1.2	12	290
04/88	530	220	<0.50	23	320
04/89	340	180	1.3	38	530

---

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

2,.007

TABLE C-2 (cont.)

HISTORICAL WATER QUALITY DATA
CARIMONA MEMBER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	8	9	10	11	12	13	108
04/83	820	--	--	--	--	--	--
11/83	--	--	--	--	--	--	1100
12/83	96	<0.05	2.6	120	<1.5	--	--
01/84	--	--	--	--	--	--	1100
03/84	--	--	--	--	--	25	--
10/85	2300	17	1500	2.7	--	1.9	--
11/85	--	--	--	--	<0.2	--	1500
12/85	650	10	1100	520	<0.8	21	820
02/86	240	6.7	420	250	<0.5	9.7	700
04/86	180	8.0	290	120	0.5	120	750
06/86	140	6.1	280	58	<0.2	130	640
08/86	160	6.7	270	67	0.2	14	580
10/86	110	5.4	220	40	<0.2	0.5	540
04/87	86	5.1	120	160	<0.2	140	450
07/87	--	0.6	150	25	<0.2	--	580
10/87	--	9.5	170	180	<0.5	--	560
04/88	160	4.5	56	79	<0.5	<0.50	200
07/88	--	1.7	34	0.3	<0.5	--	96
10/88	--	10	58	0.7	1.0 s	--	87
04/89	380	9.8	160	110	<0.5	110	530
07/89	--	9.9	99	3.6	2.1	--	340
10/89	--	12	140	5.0	<0.5	--	--
12/89	--	--	--	--	--	--	490

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

2,.007

TABLE C-3

HISTORICAL WATER QUALITY DATA
MAGNOLIA MEMBER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	OO	QQ	TT	VV	ZZ
05/82	15	--	--	--	--
06/82	--	13	--	--	--
12/82	56	13	8.9	--	--
03/84	--	--	--	--	14
10/85	49	2.9	26	140	85
12/85	31	7.3	19	93	28
02/86	36	5.2	27	92	200
04/86	120	6.0	33	280	--
06/86	27	1.0	20	83	--
08/86	19	0.6	40	99	39
10/86	32	6.4	23	77	190
04/87	130	2.5	34	63	--
04/88	160	<0.50	16	63	--
07/88	20	--	--	9.4	--
10/88	34	--	--	25	--
04/89	90	3.7	30	59	180
07/89	70	--	--	87	--
10/89	67	--	--	150	33

-- Not analyzed.

TABLE C-4

HISTORICAL WATER QUALITY DATA
ST. PETER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	200	201	202	203
10/85	--	0.5 s	--	--
11/85	120	--	2.6	0.5 s
12/85	100	2.9	2.0	1.2
02/86	72	<0.5	1.9	2.5
04/86	130	<0.2	0.2	0.6
06/86	110	<0.2	0.2 s	0.5
08/86	110	<0.2	2.7	0.5
10/86	78	<0.2	<0.2	0.5
04/87	100	0.1	<0.2	0.7
07/87	120	--	--	--
10/87	160	--	--	--
04/88	89	<0.50	<0.50	<0.50
07/88	33	--	--	--
10/88	56	--	--	--
04/89	150	<0.5	<0.5	2.1

s Potential false positive value based on statistical analysis of blank sample data.
-- Not analyzed.

2,.009

TABLE C-5

HISTORICAL WATER QUALITY DATA
PRAIRIE DU CHIEN/JORDAN WELL
TRICHLOROETHENE

(concentrations in ug/L)

DATE	HENKEL
10/85	71
12/85	44
02/86	48
04/86	OFF
06/86	OFF
08/86	54
11/86	6.9
04/87	7.1
07/87	20
10/87	6.7
04/88	13
07/88	1.5
10/88	8.0
04/89	12
07/89	10
10/89	11
	2,.010

TABLE C-6

HISTORICAL WATER QUALITY DATA
PUMP-OUT WELLS 111, 112, 113 (DISCHARGE)
PUMP-OUT WELLS 108, 109, 110 (INFLUENT/EFFLUENT)
TRICHLOROETHENE

(concentrations in ug/L)

DATE	DISCHARGE	INFLUENT	EFFLUENT
11/85	160	1200	13
12/85	140	870	12
01/86	--	1100	17
02/86	290	760	8.4
03/86	--	1700	14
04/86	400	860	11
06/86	250	--	--
08/86	350	870	6.7
10/86	190	610	1.0
03/87	320	730	6.8
04/87	170	530	8.3
07/87	310	660	2.8
10/87	230	720	<0.5
11/87	--	490	2.6
01/88	300	470	4.4
04/88	210	370	5.3
07/88	70	160	1.2
10/88	64	--	--
11/88	--	84	3.7
01/89	210	390	9.8
04/89	200	440	13
07/89	170	380	20
10/89	110	--	--
12/89	--	140	190

-- Not analyzed.

2,.011